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EDITED AND PUBLISHED IN ENGLISH AND GERMAN,

BY

PROF. H. KNAPP, M.D., AND PROF. S. MOOS, M.D.,
OF NEW YORK. OF HEIDELBERG.

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INTRA-OCULAR ENCHONDROMA, OF TWENTY-TWO YEARS' GROWTH.

REMOVED AT THE BALTIMORE EYE AND EAR INFIRMARY.

By J. J. CHISOLM, M.D.,

Clinical Professor of Eye and Ear Surgery in the University of Maryland.

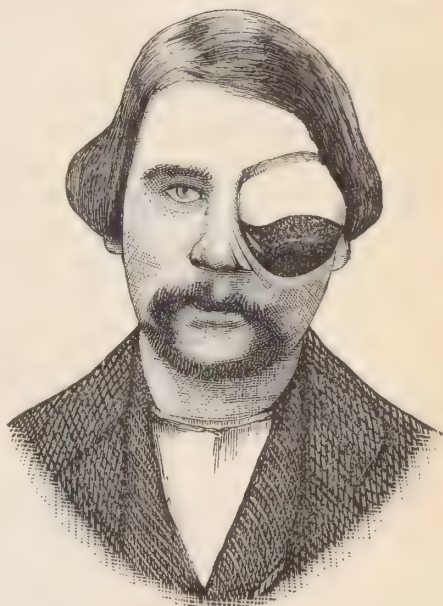
WITH A DESCRIPTION OF THE MICROSCOPIC CONDITION OF THE TUMOR.

By H. KNAPP, M.D.,

OF NEW YORK.

S. H. V——, of Virginia, aged twenty-five, was born a healthy infant. At the age of three years his parents noticed a difference in the size of his eyes, the left one being slightly enlarged. Upon further examination and by the use of tests, the sight in it was found defective. Prior to this discovery both eyes were supposed to be perfect. From that period until the present, covering an interval of twenty-two years, the left eyeball has continued steadily to increase in size, at times accompanied by pain. He has been pursuing the avocation of a farmer, and continued work until he left home to seek surgical advice. In his desire to get rid of this projecting and horrible deformity he entered the Baltimore Eye and Ear Infirmary for surgical treatment.

His general health is good, height 5 ft. 10 in., weight about 130 lbs. The right eye is perfect. In the place of the left eye, a rounded mass protrudes (see figure, from a photograph), which seems to be as large as the fist. After appar-



ently filling the orbital cavity, the growing tumor has gradually projected forwards until it has attained a prominence of $2\frac{1}{2}$ inches from a level of the face, having about the same dimensions of $2\frac{1}{2}$ inches in its vertical and transverse diameter. An immensely expanded, hypertrophied, and movable upper lid, as a broad curved belt, covered the upper three-fourths of the free surface of the projection. In this overgrown lid the orbicular muscle was well developed, as indicated by the numerous crescentic ridges which encircled the facial base of the tumor, and which were made prominent through the subcutaneous bundles of muscular fibres. On the upper and outer surface of the tumor, apparently under the thickness of the lid substance, was an elastic, soft swelling, supposed to be the lachrymal gland, pushed out of its natural site, and drawn forward by the growing mass. The mucous or conjunctival tissue covering the exposed face of the tumor was thickened, but was otherwise apparently healthy, possessing the usual mobility of this membrane over the sclerotic coat of the eye. The lower conjunctival cul-de-sac had been effaced in the continued requirements of the enlarging growth, so that the Meibomian edge of the lower lid was directly continuous with the conjunctival covering of the tumor. The upper conjunctival cul-de-sac had not been altogether obliterated, but remained as a very superficial groove separating the edge and inner surface of the upper lid from the anterior surface of the protrusion. Under the ocular conjunctiva, which, although thickened, was still translucent, an appearance of healthy, white sclerotic was visible. All traces of corneal tissue had disappeared, and in its stead was a thick, red conjunctiva, covering which were crusts of desiccated mucus. From this fleshy surface he reports that several serious hemorrhages have from time to time taken place. Of this serious complication I could detect no evidences, as there was no appearance of ulceration when the anterior surface of the tumor was exposed by the removal of the mucous crusts. There were no large vessels visible on the surface of the tumor.

The entire anterior and exposed face of the growth was kept constantly bathed by an abundant lachrymal secretion, which, in a certain oblique light, could be seen oozing from beneath the upper lid, from the direction of the soft, elastic swelling already noticed as lying upon

the upper and outer surface of the tumor, and supposed to be the lachrymal gland.

The long-continued pressure of this ever-slowly increasing growth had caused, by absorption, an increase in size and a change in direction of the outer border of the orbit. It had also in a measure displaced the nose from its median position. After leaving the orbit the growth had not spread out suddenly, becoming bulbous, but had retained a uniform diameter in every direction of about two inches and a half, which measured the degree of expansion of the orbital opening.

The whole tumor, which was uniformly ovoidal in shape, *possessed limited movements, synchronous with those of the sound eye*. When firmly held and a to-and-fro movement imparted to the hand, similar movements were extended to the growth. Careful palpation elicited no fluctuation, although a decided feeling of elasticity pervaded the entire tumor.

The history, symptoms, and appearance of the projecting mass indicated an intra-ocular tumor of very slow growth, which, after twenty-two years of steady increase, was still incarcerated within the chambers of the eye, and isolated by the much expanded and thickened, but, to all appearances, otherwise normal sclerotic coat. Believing that the eye was the seat of a malignant growth, which, from some unexplainable cause, had taken on a very irregular and unusual development, its extirpation was advised and assented to. The operation, which was performed under chloroform, in the presence of Prof. Gross, of Philadelphia, and others, was similar to the ordinary enucleation so familiar to ophthalmic surgeons. After extending the outer canthus, on account of the great size of the tumor, the conjunctiva was incised around the former site of the cornea, the tenotomy of the various muscles was easily effected, and after passing a long, heavy scissors, curved on the flat near the point, to the very apex of the conical cavity of the orbit, the optic nerve was divided, and the whole mass at once glided out of the socket, leaving a huge but apparently healthy cavity, devoid of all fat and lined from rim to apex with a thickened periosteum. Hemorrhage, not excessive, was readily controlled by sponge pressure.

The case made good progress for the first few days. On the fourth

night from the operation there was a hemorrhage of a few ounces. On the fifth night this was again repeated without the source of hemorrhage being discovered. On the evening of the ninth day a very severe hemorrhage took place, which was deemed sufficiently serious to warrant me in ligating the common carotid. On the morning of the tenth irregular tetanic symptoms supervened, and he died on the fourth day after the ligature had been applied. There had been no recurrence of the hemorrhage.

The mass removed was a smooth, regularly ovoidal tumor, about three and a half inches in its longest diameter, corresponding with the axis of the orbit, and two inches and a half in its vertical and transverse diameters. Its outer surface was the expanded and thickened sclerotic coat of the eye, which apparently had not been broken through at any point by the growth from within. To this outer surface were attached the muscles of the eyeball. When the tumor was laid open the whole sclerotic sac was found filled with a solid contents, mottled in appearance, and of varied consistence, among which were conspicuous white nodules of different sizes. These proved upon section to be cartilage, which character was confirmed by microscopic examination.

It is so very unusual to find cartilage in the growths within the eyeball, that this rare specimen of tumor was deemed worthy of a more careful examination. Prof. H. Knapp, a recognized authority on intra-ocular growths, has very kindly consented to make the examination for me, and to him are we indebted for the following carefully prepared and most valuable report of this rare pathological specimen:—

ANATOMICAL EXAMINATION OF THE PSEUDOPLASM.

The tumor (Fig. 1, Tab. A), hardened in Mueller's fluid, was roundish, having a diameter of two inches and a half. It was surrounded by connective tissue in the form of an irregularly dense *capsule* (Fig. 1, *a*). On the transverse section its bulk consisted of *hard nodes* (Fig. 1, *b*), separated from one another by *fibrous tissue* connecting with the capsule. A considerable portion of the tumor, about one-fifth of its size, was softer and had a *fibro-granular* appearance (*c*).

The enveloping *capsule* consisted in its outer part of dense undulating and parallelly striated connective tissue, containing a very scanty amount of cells and blood-vessels. Its similarity with the structure of the sclerotic was marked. The inner layers of the capsule had more blood-vessels and cells, and the layer near the nodes was filled with small round formative cells, scattered sparsely through the fibres; besides them smaller and larger cells lay together in spindle-shaped spaces between the bundles of fibres. These layers, therefore, presented the connective tissue in the state of growth or proliferation.

The *fibro-granular* part (*c*) of the tumor showed a net of connective-tissue fibres (Fig. 2) which was freely traversed by blood-vessels (*v*), and abundantly interspersed with formative cells (*f*). In addition to these elementary parts this portion of the tumor contained a good deal of fat, in the form of globules (*m*), and granulated bodies (*g*). Teased preparations of this substance showed long fibres with double outlines (*o*), spindle-shaped (*s*), stellate (*h*), and small round

cells (*r*), the latter here and there in dense clusters (*u*).

The structure of the hard *nodes* discovered the two varieties of *cartilage*, the *hyaline* and the *fibrous*, in very characteristic pictures. The *hyaline* variety (Figs. 3, 4) prevailed over the fibrous (Fig. 5). It consisted of a yellowish, homogeneous, or very finely granular, glassy-looking matrix—intercellular substance—in which cartilage-cells of different forms were embedded. Oval cells with one or two nuclei (Fig. 3, *a*); small, round, oval and irregular spaces containing three and more nuclei (*b*); large, irregular cavities densely filled with nuclei (*c*), and free nuclei (*d*), were promiscuously placed in the homogeneous hyaline basis-substance. In many places the matrix appeared interspersed with free nuclei alone (Fig. 4). Part of the nuclei were small, round and pellucid (*d*); another part were small and shrivelled up (*b*); others (*cd*) large, oval, round, club-like, dumb-bell shaped or irregular. Their interior was either homogeneous and transparent (*c*), or finely or coarsely dotted (*d*).

The *fibrous portion of the cartilage* (Fig. 5) showed an irregularly striated matrix in which the same cellular elements were embedded as in the hyaline portion. Where the nuclei predominated (*a*), the matrix had commonly a granular appearance, with fine, short lines; where the larger cells were prevalent (*b*), the matrix was markedly fibrous.

Blood-vessels ran in different directions through the fibrous part, but were absent in the hyaline portion.

From the foregoing description it is evident that the

tumor was, as Dr. Chisolm declared it to be, an *enchondroma*. There is, further, no doubt that it was, from beginning to end, an *intra-ocular* growth. The history showed the gradual enlargement of the eyeball, together with failure of sight. Had the enlargement been only apparent, due to exophthalmus, in consequence of an orbital tumor, no impairment of sight would have been noticed at the outset of the difficulty, for we see the protrusions of the eye reach very high degrees before the vision becomes impaired. The fact that the sclerotic coat, before and after the operation, was seen to envelop the growth; furthermore, the movements of the tumor concomitant with those of the other eye; the insertions of the ocular muscles into the surrounding coat—sclerotic; their division in the enucleation of the eye; the gliding of the whole mass out of the orbit after the muscles and the optic nerve had been severed:—all these circumstances show *that the growth was within the eye*. As far as I can ascertain, this case is the only one of its kind on record. I have consulted many older and modern works on morbid growths, as well as the text-books of ophthalmology, without finding a mention of intra-ocular enchondroma.

As this case introduces a new species of tumor into the field of ophthalmology, I have endeavored not only to *define its character*, but to *trace its origin and development*. If we look for analogy, and remember that cartilaginous tumors, though originating mostly in the bone and periosteum, not infrequently arise from the connective tissue of other organs, especially the fasciæ, (for instance in the parotid gland), we may assume that

the tissue in which, most likely, the above-described enchondroma took its first root, was the *sclerotic*. The exceedingly slow increase of the tumor also favors the theory that it started from the sclerotic, a tissue which, containing but a few blood-vessels, could only furnish a scanty supply of nutritive material to the pseudoplasm. We know, however, that chondromata in general are of very slow growth. The majority of them, like the present case, are first noticed in early youth ; some are congenital. The sclerotic could be recognized in this specimen with the microscope. Its outer layers appeared as usual, but the inner were infiltrated with nuclei and cells of an indifferent character, such as are found at the border of every growing neoplasm. Near by lay hyaline cartilage. There was, therefore, an immediate transition between the sclerotic and the tumor, indicating either that the cartilaginous tissue grew *from*, or grew *into* the sclerotic. The correctness of the latter view was borne out by the fact that I saw here and there stellate and angular pigment cells crowded into the sclerotic tissue. All who are familiar with intra-ocular neoplasms know how the pigment cells of the choroid move when this membrane itself is destroyed. They follow the course taken by the proliferating new elements. In spite of this, I think that the enchondroma originated in some part of the inner layers of the sclerotic, spread toward the vitreous, destroyed every tissue within the eyeball, and, after filling the globe completely, began to press and encroach upon other parts of the sclerotic, gradually expanding it by its steady increase. Thus the choroidal pigment may have

been carried with the newly-formed cells into the sclerotic when they reached and invaded the opposite side of the eyeball.

There was no indication of a special *cause* for the development of this growth. C. O. WEBER, in his statistics of 237 cases of enchondroma (*Die Knochengeschwülste*, Bonn, 1856, p. 138), showed that in about half the cases where a history was given, an injury was the cause of the chondromatous growth.

R. VIRCHOW assumes (*Morbid Tumors*, I, p. 505) that the enchondromata of the soft parts commonly originate in the interstitial connective tissue, in which "chronic inflammatory, or at least irritative" conditions lead to the new formation of connective tissue, which is the matrix of the enchondroma. The cellular elements of the connective tissue multiply by division, the intercellular substance becomes denser and more abundant, the cells are surrounded with capsules, and the cartilage is formed (Virch., l. c., p. 506).

In the case above described there was no history of a trauma. Without any inconvenience to the patient, or irritation of the eye, the globe was noticed to enlarge, sight failing, and a white reflex shining through the pupil. This evidently was caused by newly-formed tissue in the posterior part of the eye. No other than connective and cartilaginous tissues being present in our specimen, we have no reason to disagree with the great pathologist, but may assume that the first step of the pseudoplasm was new formation of connective tissue. This we find well marked in the outer layers of the specimen, from which it runs through the tumor in

various directions, forming septa between the nodes (*d*, Fig. 1), and accumulating in larger quantity in the soft portion (*c*, Fig. 1). There is still, as we have seen, an active proliferation going on in this connective tissue (Fig. 2), resulting not only in its increase, but in its conversion into cartilage. In the outer layers of the capsule nothing is found but undulating and parallel fibres, interspersed with some nuclei; in the inner layers and the septa arising from them, the nuclei become more and more numerous, and their gradual conversion into cartilage cells can be easily observed. In the softer places of the granular portion there is a network of delicate fibres, containing nuclei and small cells (Fig. 2), but in the denser places of the granular portion the cells become larger, obtain a double outline, and one or several distinct nucleoli (Fig. 7). At some points the cells lie isolated between the nuclei and fibres of the connective tissue; at others crowded together and forming clusters walled in by a fibrous capsule (Fig. 7, *d*). Two and more cells very frequently are found in the same capsule (Fig. 7, *a*, *c*, *d*). The fibres in the basis-substance have become coarse. Thus we see fibrous cartilage at the side of proliferating connective tissue in the same microscopic field of vision (Fig. 6). In some places there are smaller and larger accumulations of cartilage cells, surrounded by connective tissue which is but little changed (Fig. 7). Such accumulations are the starting points of new nodes of the growth, which, itself, is but an agglomeration of many separated or coalescent nodes (Fig. 1).

Whereas the development of the *fibrous cartilage*

could be clearly demonstrated to consist in a *gradual conversion of the connective tissue* elements (Fig. 7), the *hyaline cartilage* showed *different modes of development*.

(1.) The *isolated clusters of cartilage cells* above mentioned (Fig. 7), formed the *nuclei of hyaline nodes*, being distinguished from the cells of the fibrous cartilage by their yellow color and lustrous appearance. The deposition of hyaline intercellular substance completed the formation of true cartilage (Fig. 7, *b, c*). These yellow clusters may be likened to seeds strewn into the young connective tissue, which they gradually absorb by their own growth. Some of them contain only a few cells, but have, nevertheless, thick capsules, and represent simple breed-cells (Fig. 7, *a*); others are compound clusters, consisting of a varying number of smaller clusters and isolated cells enclosed in a common large capsule (Fig. 7, *c, d*). The microscopic picture of these compound clusters nearly resembles the macroscopic appearance of the whole tumor (Fig. 1). The growth of the neoplasm by proliferation of cells is distinctly visible in these clusters. The matrix in which they are embedded is provided with blood-vessels, which I did not see enter into one of the clusters. In some places there were embedded into the fibrous basis-substance larger *granular bodies* (Fig. 7, *e*), which do not exactly resemble the accumulations of granular fat, the dots varying too much in size, being dark throughout, viz., without a transparent centre, and irregular in outline, unlike the little circles with white centres which compose the globules of granular fat. Here and there a

nucleus was surrounded by similar dark granules (Fig. 6, *a*), resembling a coarsely granular cell body, around which no membrane was visible.

2. *The fibrous cartilage was converted into hyaline cartilage by gradual extension of the hyaline basis substance into the fibrous matrix of the fibro-cartilage.* There were numerous yellow patches of true cartilage scattered through the fibrous cartilage. The line of transition between the two was ill-defined and often imperceptible. *The hyaline cartilage, in its growth, absorbs the fibro-cartilage as well as the connective tissue.*

3. *Agglomerated formative cells were directly converted into cartilage cells by diffuse deposition of hyaline substance.* To a large extent, especially in preparations taken from the larger nodes of the specimen, the structure of this pseudoplasm presented a dense accumulation of nuclei, or small round cells, resembling medullary tissue, for instance, glioma (Fig. 8). These small, round, formative cells (*a*, Fig. 8) were mostly of the same size, finely granular, pellucid, and colorless. Some had distinct nucleoli, others had none. Their contour was always well defined. They were pervaded, in most places, by an irregular network of, mostly, coarse fibres (Fig. 8, *b*). In the immediate vicinity of this white medullary tissue, yellow, pellucid, faintly-lustrous, small and large patches (*d*, Fig. 8) appeared, which contained the same kind of cells, embedded in hyaline intercellular substance; some of these cells, however, were shrunken. These hyaline patches extended in irregular lines (*c*, Fig. 8) into the medullary structure,

communicated with one another, broadened, and encompassed smaller and larger irregular spaces, which were densely filled with formative cells. Where the deposition of hyaline substance had only begun, its border line was commonly ill-defined, as in Fig. 8; but where it had advanced further, its boundary was sharp, and the enclosed spaces resembled breed-cells, as *b* and *c* in Fig. 3, and *e* in Fig. 4. Following these patches up a greater distance from their boundary lines, I found that the small round cells—or nuclei—enlarged, became oval, had one or several distinct nucleoli; obtained body—cell contents—and capsules around them, multiplied their nuclei, and aggregated in clusters, thus exhibiting all the features of true cartilage.

The more I studied the histology of this specimen—and I employed a good deal of time at it—the more I was convinced that the increase of the tumor was less effected by multiplication of cartilage cells in the way of cell division, but by the conversion of formative cells into cartilage cells. This process was very active, both in the fibrous and the hyaline portions of the pseudoplasm. The formative cells were either sparsely strewn into the connective tissue, or so densely crowded together that they recalled the structure of marrow, or encephaloid tumors; but here and there they were surrounded by hyaline substance, which could be easily recognized by their yellow color and lustrous appearance. Thus, as in the growth of other tumors, so in that of enchondroma, the formative cell plays the most important part.

In regard to its clinical importance, the specimen

above described must be pronounced an *innocent or benign growth*. Though in very rare instances metastatic cartilaginous tumors have been observed (PAGET, VIRCHOW), there was no indication of malignance in this case. The tumor was, moreover, completely encapsuled, even after having destroyed the eyeball long before. Its first appearance in early youth, and its slow growth, are features which it had in common with chondromatous neoplasms in general.

As an *intra-ocular tumor, it is novel and unique*. The few cartilaginous tumors to be found in ophthalmological literature were located either on the outside of the sclerotic and cornea (VON GRAEFE and SCHWEIGGER, *Arch.* vii. 2, p. 5), or in the orbit (FANO, *L'Union Médicale*, 1859, t. iii., p. 557, reprinted in *Demarquay's Tumours de l'Orbite*, p. 365, and MACKENZIE, *Treatise*, 4th Edition, p. 330).

The removal of the tumor was indicated, and, if done at an earlier time, would probably not have been followed by after-hemorrhage and its fatal consequences.

I would not omit to thank Prof. Chisolm very cordially for having kindly given me the opportunity of examining so interesting a specimen, which, on account of its rarity, forms a very valuable contribution to the knowledge of ocular tumors. This being the first and only case of its kind ever observed in that locality, I took particular pains to investigate, describe, and illustrate it in such a way as to leave no uncertainty with regard to its nature.

As there are, in reality, no unique cases, I doubt not

that this observation of an intra-ocular enchondroma will soon be followed by others. H. KNAPP.

NEW YORK, NOV. 7, 1872.

EXPLANATION OF THE DRAWINGS ON PLATES A AND B.

Fig. 1. *Section through the Enchondroma.*

- a.* Fibrous capsule.
- b.* Hyaline nodes.
- c.* Fibro-granular substance.
- d.* Fibrous septa between nodes.

Fig. 2. *Proliferating connective tissue and its elementary parts.*

- g.* Fat in granulated bodies.
- f.* Formative cells.
- m.* Fat in isolated globules.
- t.* Net of connective-tissue fibres.
- v.* Blood-vessels.
- o.* Long fibres with double outlines.
- s.* Spindle-shaped, *h*, stellate, and *r*, small round cells.
- u.* Small round cells in clusters.

Fig. 3. *Hyaline cartilage.*

- a.* Oval cell with two nuclei.
- b.* Smaller irregular spaces containing several nuclei.
- c.* Large irregular cavity densely filled with nuclei.
- d.* Free nuclei.

Fig. 4. *Hyaline Matrix interspersed with free nuclei.*

- d.* Nuclei, small, round, and pellucid.
- b.* Nuclei, small and shrivelled.
- c.* Nuclei, large, oval, round, club-like, dumb-bell-shaped, or irregular.

Fig. 5. *Fibrous cartilage.*

- a.* Nuclei in a granular or finely striated matrix.
- b.* Larger cells in a coarsely fibrous matrix.

Fig. 6. *Fibrous cartilage developing from proliferating connective tissue.*

- a.* Nucleus surrounded by dark granules.

Fig. 7. *Smaller and larger accumulations of cartilage cells in connective tissue.*

- a.* Simple breed-cells.
- b, c.* Deposition of hyaline substance around the cells.
- d.* Large capsule.
- e.* Coarsely granular bodies.

Fig. 8. *Agglomerated formative cells, converting into hyaline cartilage.*

- a.* Small round pellucid cells, densely accumulated, as in medullary tissue.
- b.* Network of coarse fibres pervading the cells.
- d.* Yellow, pellucid, and faintly-lustrous patches, extending
- c.* in irregular outlines into the medullary tissue.

ERRATUM: The small letter *a* on the left border of Fig. 8 should be *d*.

LEPTOTHRIX IN THE UPPER CANALICULUS.

BY DR. EMIL GRUENING,

OF NEW YORK.

(See Table C, Figs. 1-4.)

IN 1854, Von Graefe described the first case of fungoid concretions in the lower canaliculus.* Within the subsequent period of fifteen years, from 1854 to 1869, Von Graefe noted nine additional cases of this kind.† An accurate microscopical examination of these concretions was first made by Cohnheim in 1865, who found them to consist of leptothrix elements.‡ Besides the ten cases reported by Von Graefe, Förster's case of leptothrix masses in the lower canaliculus is known.§ Quite recently Schirmer, of Greifswald, published a case, demonstrating the existence of this fungus in the *upper* canaliculus.|| The following case, in all respects similar to Schirmer's, is the second on record:—

An Irishman, fifty years of age, who was treated at the New York Ophthalmic and Aural Institute for chronic conjunctival catarrh and epiphora of the right eye, presented himself in May, 1872, with an acute inflammatory intumescence of the caruncle, semi-lunar fold, adjacent conjunctiva, and a cylindrical swelling along the course of the right upper canaliculus. The upper punctum was considerably en-

* Arch. f. O. I. I. p. 284.

† Arch. f. O. XV. I. p. 324.

‡ Arch. f. O. XV. I. p. 326.

§ Arch. f. O. XV. I. p. 318.

|| Klin. Monatsbl. f. Augenheilk. 1871, p. 248.

larged, crater-shaped, and the corresponding portion of the lid everted. On raising the lid from the eye-ball and compressing the tumor between the thumb and fore-finger, a scanty drop of a viscid, yellowish, pus-like substance made its appearance at the punctum. After wiping away this substance the pressure was continued, without, however, effecting a further discharge. The tumor had not diminished in size. The region of the lachrymal sac was intact. *Mutatis mutandis*, the ensemble of the disease corresponded so perfectly with Von Graefe's description of leptothrix in the lower canaliculus, that the diagnosis of fungi in the upper canaliculus was not difficult.

Prof. Knapp examined the patient subsequently, made the same diagnosis, and slit the canaliculus with Weber's knife. The calibre of the tube was found to be enormously distended. With the aid of Daviel's spoon, five yellow, roundish concretions, severally of the size of a pin's head, were removed. The masses had an uneven surface and were of soft consistence. The aperture leading into the lachrymal sac was obliterated. The patient refused to have it opened. After a few days all the inflammatory symptoms of the right eye had subsided; the epiphora had not diminished.

On microscopical examination the concretions were found to be opaque, owing to their impregnation with chalky particles. These readily dissolved in dilute hydrochloric acid. The leptothrix elements then came into view in the shape of long filaments and rods (Fig. 1. Tab. C), which, on adding iodine, assumed a light blue tinge. In this reaction they differed from the leptothrix masses of the lower canaliculus examined by Leber and Waldeyer, who never observed a similar coloration.

Hallier's observations on the morphological relations of penicillum glaucum and leptothrix* induced me to cultivate the fungi removed from the upper canaliculus.

Two shallow glass cups were half filled with glyce-

* Mohl und Schlechtendahl's *Botanische Zeitung*, 1866, N. 23, p. 187.

rine. Into one of these I threw several fragments of a finely divided leptothrix concretion, and, in order to exclude the air, covered both cups with heavy glass plates. The fragments sank immediately to the bottom of the cup. The next day every leptothrix particle was found to be surrounded by a very delicate, whitish, gossamer-like zone. Twenty-four hours later these zones had considerably increased in size. They extended to the surface of the glycerine and here passed into a thick, bluish-green layer. The microscopical examination revealed that the delicate, gossamer-like substance consisted of filaments of penicillum (Fig. 2, *b* and *c*; Fig. 3), the greenish-blue layer of pencil spores (Fig. 4).

The glycerine of the other cup was very carefully examined with the microscope, but no organic elements were detected.

EXPLANATION OF THE FIGURES.—TABLE C.

Fig. 1.—Filaments and rods of *Leptothrix canaliculi superioris*.

Obtained by cultivation of *Leptothrix* in glycerine :—

Fig. 2.—(*b*) Fragment of a branch of *Penicillum*. (*c*) Articulated plant of *Penicillum*.

Fig. 3.—Fragment of branch of *Penicillum* containing vacuoles.

Fig. 4. Branch of *Penicillum* with pencil spores.

Magnified 840 diameters.

ERRATUM. The first four figures of plate C were drawn by Dr. E. Gruening, the fifth by Mr. Wright, the sixth by Dr. A. Barkan, the seventh only by Dr. H. Knapp, but not the whole plate. By mistake of the lithographer his name alone was placed on the plate.—EDITOR.

SPONGY EXUDATION IN THE ANTERIOR CHAMBER.

BY DR. EMIL GRUENING,

OF NEW YORK.

PROF. SCHMIDT, of Marburg, recently described several cases of acute iritis characterized by peculiar and hitherto undescribed exudation masses in the anterior chamber.* He dwells chiefly upon a form of exudation which presents the appearance of a cataractous lens dislocated into the anterior chamber.

Referring to Schmidt's article, Gunning, of Amsterdam, reports three cases in which lens-like exudation masses came under his observation.† Gunning styles this exudation gelatinous, and states that it is poured out into the anterior chamber suddenly and abundantly, and passes away within a few days without leaving any trace.

When I read the description of Schmidt's and Gunning's cases, I was already acquainted with this peculiar exudation, though I had not yet observed it in idiopathic iritis. Prof. Knapp had first called my attention to the occurrence of a certain form of exudation after operations upon the iris. Knapp characterizes this exudation as spongy. About twenty-four hours after

* Klin. Monatsbl. f. Augenheilk., 1871, p. 94.

† Klin. Monatsbl. f. Augenheilk., 1872, p. 7.

an iridectomy, the anterior chamber may be found more or less filled with a brownish shapeless mass, consisting of very fine filaments, crossing each other at various angles, and thus forming an irregular network, which presents a striking resemblance to the gross structural arrangement of a sponge. This spongy exudation either disappears directly in this form, or indirectly—*i. e.*, after having been transformed into a bluish-white, homogeneous, and sharply-defined mass. This observation shows that the gelatinous exudation (Gunning) is in reality a transition stage of spongy exudation (Knapp).

The following case is illustrative of the occurrence of spongy exudation and its consecutive gelatinous stage in syphilitic iritis.

On March 22, 1872, I was called to see Mr. A., aged 40, who for the past few days had been suffering from an inflammatory affection of the right eye.

The patient stated that two years previously he had contracted syphilis, which had manifested itself in the form of a cutaneous eruption, and of iritis of the left eye. He feared that the right eye had now become similarly affected. On examination I found iritis gummosa. Photophobia and lachrymation were excessive. Pain very severe. Pericorneal injection marked. Iris discolored, the inner and outer parts of its pupillary edge broadly adherent to the anterior capsule. From the outer part of the smaller iris circle, near the attached pupillary edge, a gummy nodule of the size of a pin's head jutted into the anterior chamber.

I ordered instillation of atropine, application of leeches to the temple, friction with gray ointment, and made a hypodermic injection of corrosive sublimate.

The next morning I found that the inner synechia had given way, while the outer had not yielded, and the nodule had grown to the size of a split pea.

All the inflammatory symptoms had increased: the pain was excessive.

March 24.—*The anterior chamber is completely filled with spongy exudation*, through which the iris, pupil, and nodule are still discernible. The inflammatory symptoms have not abated.

March 25.—*The exudation appears transformed*. It is bluish-white, homogeneous, like a soft cataract, and above and at the inner side sharply defined by a convex edge, beyond which a crescentic rim of the iris is visible.

The area of the pupil, the greater portion of the iris, and the gummy nodule are hidden behind the mass. No diminution of the inflammatory symptoms.

March 26.—Same condition.

March 27.—Morning. *Fætor mercurialis ex ore* and slight ptyalism. *The exudation has disappeared without leaving any trace*. The gummy nodule is reduced to the size of a pin's head. The area of the pupil is free. The patient has no pain, and feels quite well.

March 29.—The gummy nodule has disappeared; the broad synechia, however, resists the action of atropine, and does not yield.

The foregoing case, in many respects similar to Schmidt's and Gunning's cases, is of particular interest: first, on account of the simultaneous occurrence of a gummy nodule and spongy exudation; and, secondly, on account of the observation of the transition of the spongy exudation into the gelatinous.

EXOPHTHALMUS DEXTER APPEARING DURING INCLINATION OF THE BODY FORWARD, AND DISAPPEARING IN THE ERECT POSITION.

BY DR. EMIL GRUENING,

OF NEW YORK.

THE literature of exophthalmus is so exceedingly ample that the publication of additional cases of this affection seems unnecessary. Yet I do not deem it superfluous to make the following case known, as it presents new and hitherto unobserved features, and differs, as regards its origin, from the cases on record. I have searched the literature on this subject very extensively, but have found no mention of an exophthalmus depending *solely* upon an inclined position of the body.

In August, 1871, S. W., aged 45, a teacher of music, was sent to my office by Dr. S. Hahn, of this city. The patient, though weakly built and pale-faced, had always enjoyed good health. He states that five years ago, while engaged in carpeting a floor, in a stooping position, he suddenly experienced a sensation of weight and falling of the right eye. On placing his hand over it, he found that it protruded in reality. He then rose, looked into a glass, but failed to detect any change in the position of the eye. On bending forward to resume his work, he immediately noticed that the eye was again driven out. He remained calm, and after finding that his sight was not materially

impaired, tied a handkerchief over the eye, in order to keep it in place, and quietly finished his work. Since that time the exophthalmus appears during every inclination of the body forward, and disappears in the erect position.

When standing the patient looks somewhat goggle-eyed, especially so on his right side. In the recumbent position the right eye does not stand out beyond the level of the left. Both eyes have a normal range of mobility in all directions. On extreme abduction the outer edge of the cornea reaches the external canthus; on extreme adduction, the inner edge of the cornea touches the caruncle. The examination of the refraction and sight shows R. M. $\frac{1}{4\frac{1}{2}}$, S. $\frac{2}{5}0$; L. M. $\frac{1}{6}$, S. $\frac{2}{7}0$. The patient reads Jaeger 1 with either eye.

Ophthalmoscopic appearances:—Refracting media clear. Optic discs pale and somewhat atrophic. Extensive staphylomata postica completely surrounding the papillæ. Retinal arteries thin; veins of normal size, but tortuous.

The patient is color-blind. He is neither able to distinguish red and all those colors of which red forms a component, nor its complementary color, green, but appreciates yellow and blue.

Fields of vision of normal extent. No derangement of the heart's action. No enlargement of the thyroid gland. Whenever the patient but slightly inclines his head or body, the right eye is immediately thrust forward. This straightforward protrusion of the eye increases with higher degrees of inclination, and is greatest—measuring 15 millimetres—when the patient bends his body forward and downward in such a manner as to touch the floor with both hands. A horizontal line drawn across the rather prominent bridge of the nose impinges upon the vertex of the cornea. The mobility of the prolapsed eyeball is greatly reduced. It has only a very slight degree of mobility inward, but absolute immobility upward, outward, and downward. Any attempt to evert the eye causes intense pain. Sight and field of vision remain unchanged. On gentle and continued pressure the eyeball recedes into the orbit, but slips out again as soon as the pressure is released. No bruit is heard on auscultation over the right temporal region. No diminution of the exophthalmus noticed after compressing either the right carotid alone, or both carotids simultaneously.

When I related this singular case at the January meeting (1872) of the New York Ophthalmological Society, Prof. Knapp, who at my request had kindly examined the patient, expressed the opinion, that in all probability the protrusion of the eyeball was caused by the gravitation of blood into the pathologically cavernous, retro-ocular tissue of the orbit.

A CASE OF CORËCTOPIA.

By THOMAS R. POOLEY, M.D.,

OF NEW YORK,

Ophthalmic Surgeon to Charity Hospital, Assistant Surgeon to the New York Ophthalmic and Aural Institute.

(See Fig. 5, Table C.)

CASES of this anomaly are so rare, and the reference to them so scanty, in recent literature, that no excuse seems necessary for reporting this one. Very few of the text-books even allude to it. Soelberg Wells* gives a brief description of it, and refers to two cases which he had under his care at the Royal Ophthalmic Hospital, occurring in two sisters. In each eye the pupil was displaced (in which direction is not stated), and the lens dislocated, both these conditions being congenital. I have not been able to find any more detailed account of his cases.

Bader† says that displacement of the pupil occurs most frequently upwards. Displacement of the pupil beyond the margin of the crystalline lens has been observed.

Wecker‡ gives a better description of the deformity

* Treatise on Diseases of the Eye, 2d Ed., p. 180.

† The Human Eye : its Natural and Morbid Changes, p. 350.

‡ Maladies des Yeux, Vol. I., p. 404.

than any of the text-books which I have examined. He describes the affection as corectopia, or congenital displacement of the pupil, and considers the condition due to an irregularity in the development of the larger circle of the iris, in such a way that it assumes on one side a normal or excessive size, while on the opposite side, or in some other direction, it is arrested. He refers to the fact that in normal eyes the pupil does not occupy exactly the centre of the iris, but lies a little to the inside or outside of this point.

In cases where the corectopia is very pronounced, not only is the pupil very eccentric, and separated from the adherent border of the iris only by a narrow band of this membrane, but it loses its circular form, becoming oval or lance-shaped. Simple corectopia has no bad effect upon the visual acuteness.

Galezowski* describes this anomaly as characterized by a displacement of the pupil towards the periphery of the iris. He also refers to the deviation of the pupil from the centre of the iris even in normal eyes, and an exaggeration of this condition constitutes corectopia. This irregular conformation of the pupil may be accompanied with other congenital alterations, such as cataract, and luxation of the lens.

Dixon† reports a case of congenital corectopia. The patient, a young man, was a waiter in an inn, and able to attend to all the duties of his business. No examination as to his acuteness of vision was made. In each

* *Traité des Maladies des Yeux*, p. 371.

† *Royal Ophthalmic Hospital Reports*, Vol. I., p. 109.

eye the iris was tremulous. The fibres all radiated in a uniform manner from the pupil to the margin of the cornea. At the inner and lower portion of the anterior chamber, the iris suddenly became a little convex, as if pushed forward by the lens, which had been displaced, in a direction downward and inward. In consequence of the relative position of the pupil and lens, the patient did not look through the latter, but to one side of it. There was no diplopia. The report of the case is accompanied with a drawing, which represents the patient as looking straight forward, the lids being raised to show more distinctly the outlines of the cornea and pupil. The pupils are upward and outward.

In the excellent atlas of Von Ammon* are figured a number of cases of this deformity, representing all degrees of deviation of the pupil from its normal position. The condition is thus described by him: Corectopia is the condition of the iris where one segment is narrower than the other, so that the pupil does not lie exactly in the middle, but more or less to one side. The pupil is most often found in the upper segment of the iris, more seldom downward, or toward the inner side, still rarer is it found outward. With such a congenital displacement, an abnormal form of the pupil is almost always associated (dyscoria); it is angular, jagged, oval, or heart-shaped, its longest diameter being perpendicular, transverse, or oblique. The condition is most common

* Klinische Darstellung der angeborenen Krankheiten des Auges und der Augenlider, p. 36, Tab. ix.

in microphthalmic eyes, and very often there is an abnormal color of the iris, also affections of the lens, or its capsule, so that the entire development of such eyes shows a morbid tendency.

Anatomical examinations of such eyes, until then, had not been made, at least had not been published. The author made an anatomical examination of an eye with corectopia. In this case, the very small round pupil in the left eye of a child was situated downward and inward. The eye was cut through from above downwards, a few lines behind the cornea.

The *corona ciliaris* was well developed; the retina was strongly folded towards the inner side; the central foramen was wanting; the yellow spot oblong, and the plica retinæ well developed. The uvea was very dark; the pupil very small, and its edges were smooth; the region of the ciliary processes was more oblong than circular.

In answering the questions, whether corectopia originates alone, or in connection with dyscoria and polycoria, and whether this condition is to be considered only as an arrest of development or a pathological process as well, we learn from the following, that is to say, we have here a combination of an arrest of development with a pathological process. In the earlier period of development of the eye the iris is wanting; it first appears as a blue and narrow ring, at a time when the choroidal fissure has closed and the ciliary processes have formed. This ring is not of equal width at all points, but is somewhat narrower on the inner side. This peculiarity seems to depend upon the fact that the

growth of the ring is less vigorous from the lower point of closure of the choroidal fissure than from the other peripheral parts of the ciliary body. This may also be the reason why, in a perfectly developed iris, the lower segment is narrower than the upper, and the pupil never lies exactly in the centre. If this peculiar process of development slightly transgresses its limits, it may very well assume a pathological tendency, and cause corectopia in its various grades and with its usual complications, dyscoria and polycoria. Corresponding to the various deviations in the development of the larger circle of the iris, different degrees of corectopia may be determined. GESCHEIDT has designated three varieties. The more strongly marked is the corectopia, the more irregular will the form of the pupil be (dyscoria), which may easily pass into polycoria. As far as Von A. can judge of the origin of the formation of the irregular pupil, he is of opinion that it depends upon arrest of development in the larger iris circle, causing an irregular formation of the parenchyma of the iris, and this again influences the shape of the pupil, and chiefly of the pupillary margin. When there is an excess in the growth of a part of the pupillary margin, forming a tongue-like projection, or a filiform prolongation, reaching to an opposite point of the pupillary margin and coalescing with it, a division of the pupil into two or more openings (polycoria) takes place. The shape of the supernumerary pupil is not circular, but more or less oval, or slit-like: the site of this pupil is variable. These pupils do not lack mobility; they move spontaneously as well as under the influence of belladonna, but

in different degrees; double or triple vision is never caused by them; myopia, however, is generally its consequence.

GESCHEIDT has made some valuable contributions to the knowledge of this subject. Von Ammon refers to his paper on "Irideremia, Irido-schisma, and Corectopia," which was published in Von Walther's and Von Graefe's *Journal*, vol. xxii., parts 2 and 3. I have not been able to obtain access to these publications myself.

With this brief résumé of the literature of the subject, I will proceed with a description of the case which came under my observation :

The patient, aged thirty-three years, came to the clinic of the New York Ophthalmic and Aural Institute to be treated for a catarrhal conjunctivitis. On looking at him, the deformity which we are about to describe was at once apparent, although it gave him no trouble, nor did he seek advice about it.

In the right eye there was a small, oblong pupil, situated in the lower and somewhat inner segment of the iris, leaving only a narrow rim or margin of iris between the pupillary and ciliary margins (Fig. 5, Tab. C). The iris was of a dark brown color, the same as that of the other eye, and the striæ very distinct. The pupil responded slowly to light and atropine.

The anterior chamber was of normal depth, except, perhaps, in the part corresponding to the natural pupil, where the iris seemed nearer to the cornea than elsewhere. There was a diffuse opacity of the cornea situated directly in front of the pupil. Upon dilating the pupil with atropine the lens was found to be opaque. The opacities radiated from the periphery towards the centre, and the nucleus also was somewhat opaque, but the eye could be sufficiently illuminated to recognize the details of the fundus, which were found normal. There was no microphthalmos; the eye being of the same size and tension as that of its fellow. The right eye was emmetropic; $V = \frac{5}{200}$.

The other eye was normal in every respect, Em. S= $\frac{2}{3}$ °. He says that so far as he can remember he has never seen well with the right eye. There was a well-defined, narrow arcus-senilis in both corneæ.

In the accompanying figure (5, Tab. C), which was drawn for me by Mr. Wright, the position of the pupil is very accurately shown.

This case is reported more on account of its rarity than for any other reason, and I have very few remarks to offer about it. I may mention that it goes to confirm the opinion of the authors from whom I have quoted, that eyes with corectopia are likely to be abnormal in other respects. It is probable that the cataract in this case was also congenital, as the patient never saw well with the affected eye.

I am inclined to think that the corneal opacity was the result of some inflammatory process, although the patient does not remember ever to have had any trouble with his eyes before. Therefore it too may have been congenital.

EMBOLISM OF A BRANCH OF THE CENTRAL RETINAL ARTERY.

BY DR. A. BARKAN,

OF SAN FRANCISCO.

(See Fig. 6, Tab. C.)

THE small number of recorded cases of Embolism of a Branch of the Central Retinal Artery* seems to make it desirable to publish new observations of this affection.

In the beginning of last summer I was consulted by Mira K...ll, the daughter of a wealthy farmer from the southern part of California. She was 26 years of age, unmarried, blond, anæmic, and sickly-looking, and complained of great impairment of sight in her left eye. She stated that she had had scarlet fever when twelve years old. Since that time she had repeatedly suffered from inflammation in her right ankle and knee joints, which always had been connected with considerable swelling and great pain, obliging her to be in bed for a long time. This state had continued until a year previously, when the pain and swelling of the joints had gradually disappeared, and her leg regained its strength and usefulness.

About a month ago she had a pneumonia of moderate intensity, which kept her in bed for two weeks. When she was up the second time, and sat quietly in an arm-chair, without making any bodily or mental effort, she suddenly fainted; and when she came to in a few minutes, *she noticed with terror that she had become blind in both eyes.* Half an hour later the sight rapidly and completely returned in the

* Saemisch and Hirschmann, Zehender's Klin. Mon., 1866, p. 37; Knapp in Arch. of Ophthal. and Otol., Vol. I., No. 1, p. 64.

right eye. The left remained totally blind for a whole hour, after which she could recognize with it large objects near by. Since that time till now two weeks have elapsed, during which no material change in the condition of her eyes has taken place.

Status præsens: The examination of the exterior of both eyes shows no change. The mobility of both eyes is normal. The pupil of the left eye responds readily to bright day-light, though somewhat more sluggishly than that of the right. The tension of the left eye-ball is slightly diminished. Both eyes are emmetropic, R S=1, L S= $\frac{1.5}{20}$. A point of the lower half of the retina being used for fixation, the visual field of the left eye shows a defect which occupies its whole lower half. On direct ophthalmoscopic examination the refracting media are clear. A striking difference, both in color and outline, appears between the upper and lower halves of the left optic disc (fig. 6, Tab. C.). While the lower half is yellowish, red, almost hyperæmic, and its margins pass imperceptibly into the adjacent retina, the upper half of the disc is sharply defined, pale, and atrophic.

The condition of the retinal *vessels* is characteristic. The arteries and veins in the lower half of the retina are perfectly normal, with the exception of a small place at a distance of about the length of the diameter of the optic papilla from the lower margin of the disc, in which place the lower arterial branch dips into the tissue of the retina, and becomes thin and indistinct, but reappears after a short interval with distinct outlines and normal calibre (see fig. 6). At first sight there appears to be a scarcity of blood-vessels in the upper half of the retina; but on exact accommodation we recognize, besides the veins, which are straight in their course and somewhat reduced in calibre, also the branches of the central artery in the upper half of the retina. These branches, from their point of emergence, appear thread-like, pale-red, and, in their course through the retinal tissue, bordered by narrow yellowish ribbon-shaped streaks. At the distance of one to one and a half diameters of the optic papilla the arterial branches have become so thin that they can no longer be recognized. The remaining background of the eye, and, in particular, the region of the yellow spot, appear perfectly normal. On moderate pressure on the globe distinct pulsation can be seen in the inferior, but no change in

the superior, arteries. The examination of the heart revealed no disease.

We have evidently to deal in this case with an embolism of the upper branch of the central retinal artery. Although the patient's statement that *both* eyes had simultaneously become blind may not be entirely reliable, we have no reason to doubt that the left eye was totally blind for a whole hour. In all probability the embolus had completely obstructed the calibre of the left central artery during that time, and then was thrust into its upper branch.

The treatment, consisting in two applications of Heurteloup's leech and mild aperients, proved without benefit. Some weeks ago—that is, about ten months after the commencement of the disease—I saw the patient again, and found her sight, the limitation of her visual field, and the ophthalmoscopic appearance of her left eye in the same condition as before.

EMBOLISM OF BRANCHES OF THE CENTRAL RETINAL ARTERY.

By H. KNAPP.

(See Fig. 7, Tab. C.)

THOUGH obstructions of branches of the central retinal artery have only seldom been described, my observation teaches me that they are not so very rare. The unmistakable case of Dr. A. Barkan, reported in the preceding paper of these Archives, induces me to describe three other observations of the same kind, as they are noted in the journal of my private practice:

CASE I. Mrs. Catherine Lambert, of this city, thirty-six years of age, consulted me, May 15, 1871. Five months previously, four weeks before a normal confinement, she experienced, without any other symptoms, a sudden haze before her right eye, which entirely obscured the vision for a few minutes, then rapidly and completely cleared up in the lower half of the visual field of that eye, whilst the upper half remained perfectly dark. Two years previously, shortly before, and soon after the blindness set in, she had attacks of acute pain under her left breast, which her family physician ascribed to pleuritis.

Present condition.—The lower main branch of the central retinal artery of the right eye is like a thin red thread, lined on both sides by a white streak. The secondary branches show the same condition. The red central lines disappear at a short distance from the papilla, while the white streaks remain visible somewhat farther toward the periphery. The arteries in the upper half, and the veins in the whole ophthalmoscopic field of vision, appear normal. The optic disc is red-

dish in its upper, but white and punctate in its entire lower half. The fundus of the right eye, in general, has the same normal appearance in the upper and lower halves; and, moreover, does not differ from that of the left eye, which is normal in structure and function. The upper half of the visual field of the right eye is completely absent, while the vision in the lower appears perfect. She reads Sn XX at 20' distance with either eye. The sounds of the heart are normal. No other disease than that of the right eye can be discovered. The sight has not changed since the second day after the attack of blindness.

CASE II. Mrs. Jul. Kahn, of this city, 21 years of age, consulted me, August 22, 1872. She had had good eyes until fourteen months previously, when one day during her seventh month of pregnancy, while she was sewing, her left eye suddenly, without pain or irritation, became blind. At the time of this accident, as well as for a short interval before and after it, she frequently suffered from palpitation, headache, dizziness, and was easily excited. Her sight improved steadily the first month after the sudden attack of blindness, but since that time it has remained stationary in the condition in which it still is.

Status præsens. The upper half of the visual field of the left eye is completely absent. $S = \frac{2}{4}\%$. The lower half of the optic disc is intensely white, the upper half somewhat whiter than usual and the disc of the other, perfectly normal, eye, yet differing distinctly from the lower half by a marked admixture of red. The inferior branches of the central retinal artery are very thin, and bordered with white stripes. The calibre of the upper retinal arteries is also a little smaller than in the other eye, but a great deal larger than that of the lower arteries. The veins are of normal thickness throughout. The appearance of the background of the eye, apart from the optic disc and arteries, presented nothing unusual.

CASE III. Mrs. Dietr. Hornholtz, of New York, 37 years old, consulted me, March 29, 1872. She stated that six years previously she had felt ill, feverish, chilly, and weak. She had suffered from headache and palpitations, but not from articular rheumatism. In this state of health, when she was sewing one afternoon, both her eyes became suddenly obscured, and she experienced intense headache. In the

course of a few minutes her left eye cleared up, but the right remained dark much longer, improving gradually in a few weeks to the condition in which it has continued ever since.

Status præsens:—No outward changes visible. Sounds and size of heart normal. $S = \frac{2}{2} \frac{0}{0}$ in the right, $= \frac{2}{4} \frac{0}{0}$ in the left eye. A sector of the visual field of the left eye, comprising its inner and upper third, was absent. It was bounded inwardly by the horizontal meridian, and upwards by a line passing from the point of fixation diagonally across the upper and outer quadrant. A full quarter—the lower-outer—of the optic disc was white and punctate, the remainder reddish, as usual (Fig. 7, Tab. C). One arterial trunk, the lower and outer, was exceedingly thin, and bordered on both sides by a white line extending about 1 P (diameter of papilla) beyond the limit of the optic disc. No other abnormality was seen in this, and none at all in the other eye.

The CHARACTERISTIC FEATURES in all these cases are :

1. *Sudden appearance* of the *impairment of sight*, which at first manifests itself as an obscuration of the whole visual field of the affected eye, but more or less rapidly disappears in one part, leaving a defect in the upper or lower half.

2. When a primary branch of the central retinal artery is obstructed, it results in *superior* or *inferior hemiopia*; but when a secondary branch only is obstructed, a *sector-like* defect in the upper or lower half of the visual field is observed. At least one border-line of both the hemiopic and sector-like defects coincides with the horizontal meridian.

3. The portion of the optic papilla lying in the opposite direction to the defect in the visual field, becomes white and punctate—*partial atrophy of the optic nerve*—which is well set off by the remainder of the papilla retaining its usual appearance unchanged.

4. The obstructed arteries become *thin, seamed with white streaks, and disappear a short distance from the papilla.* The veins are not changed.

I do not know what other diagnosis than that of an embolism of branches of the central retinal artery could be derived from this series of symptoms. The cases of sudden impairment of sight and sector-like defects in the visual field which I have described, and explained by embolism of a ciliary artery (Graefe's Archives, xiv. 1, p. 237, etc., 1868), differ from those under consideration, in that the affection is only temporary, and connected with hyperæmia and œdema, instead of anæmia and atrophy of the retina. I do not doubt that many observations of superior or inferior hemiopia, for which no cause was found, were cases of embolism of a branch of the central retinal artery, and will in future be ascribed to it. All the symptoms above mentioned may not in every case be pronounced, but a part of them will render the diagnosis more or less probable. I recollect having seen cases of superior or inferior hemiopia in which only the opposite half of the disc was atrophic, but the arteries moderately well filled. This does not exclude embolism of a retinal arterial branch, as we see the same condition in embolism of the whole central retinal artery. It shows that a communication of the retinal with a collateral artery has been established.

CASE OF EPITHELIOMA OF THE CHEEK AND LOWER EYELID—REMOVAL —BLEPHAROPLASTY.

DR. J. H. POOLEY,

Surgeon to the St. John's Riverside Hospital, Yonkers, N. Y.

WILLIAM RAFFERTY, aged thirty-seven, born in Ireland, occupation laborer, married, had six children: two are dead, four living. His father and mother are dead; neither they nor any other of his relatives ever had any disease similar to his own. His right eye is sightless and wasted (*Phthisis bulbi*), from an inflammation which destroyed it in early life, the result of an attack of small-pox, which has left abundant traces of its ravages upon his face, which is badly pitted, particularly on the forehead.

His health is not good: he has had cough with severe dyspnœa and palpitation for several years. Upon making a physical examination of his chest, a very marked and loud cardiac murmur was found to exist, mitral regurgitant in character, with hypertrophy and excessive action of the heart. It was thought by one physician who examined him that he had also an aortic murmur, but I could not detect it.

His appetite and strength are fair, and when he does not exert or hurry himself, his heart disease does not trouble him very much; but anything like haste or excitement makes the dyspnœa intolerable. Up to this time he has had no dropsical symptoms. He is of a dull, phlegmatic temperament, and not over-intelligent.

Four years ago he was working in a brick-yard, and his face frequently became covered with sand and sweat, which he was in the habit of rubbing off with the sleeve of his red flannel shirt, particularly around the lower lid and corner of his left eye, where it was most troublesome. To the irritation thus produced he attributes a small sore, which made its appearance at that time upon the lower eyelid.

This, when it first attracted his attention, was not much larger than a large pin's head, and has been steadily increasing in size ever since. It has been treated from time to time with various salves and caustics ; but without any effect, except perhaps that of stimulating and hastening its growth. At present there is a large oval-shaped epithelial growth occupying the whole of the lower eyelid, and the upper part of the cheek ; it extends beyond both the internal and the external canthi ; is three inches in length, and one and a half in width. It projects considerably from the surface, and its irregular fungating summit is curled over the base somewhat after the fashion of a mushroom. It



Fig. 1.

is covered with a black adhesive crust, probably the result of nitrate of silver which he has been applying to it, and discharges a watery fluid, which is sometimes offensive. It has never been very painful, but is the seat of a constant burning sensation, and occasionally of a troublesome itching. The cervical and sub-maxillary glands are not enlarged. The appearance of the growth is seen in Figure 1, taken from a photograph.

Rafferty was admitted into the St. John's Riverside Hospital, April

24th, 1871, for the purpose of having the growth removed by operation. The operation was performed on the 27th, three days after his admission, and, owing to the fears entertained by some present of its effect upon his diseased heart, without an anæsthetic, although I did not myself share in these apprehensions. The morbid growth was freely removed, even to portions of it extending slightly within the orbit. This was not done by any previously planned incisions, but by circumscribing it with the knife, and following it up where any suspicious-looking tissue was discovered.

The large gap or cavity thus formed, and which at first looked quite formidable, was then restored by flaps modelled after its size and shape, and derived from the nose and forehead.

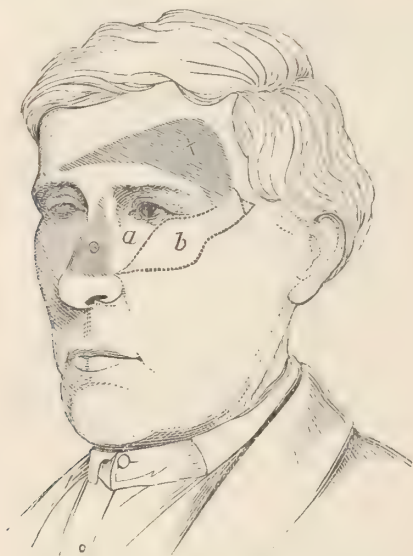


Fig. 2.

An incision was carried down from the inner canthus (Fig. 1) along the outer border of the ala nasi nearly to the tip of the nose, then across to a point just beyond the middle line or bridge of the nose, then upward parallel to the bridge to a point one inch from the point of starting.

The flap thus dissected up was triangular in shape, its truncated sum-

mit forming the pedicle. It is seen at *a*, Fig. 2; its length was one inch and seven-eighths; its breadth one inch and a half; the breadth of its pedicle one inch.

In forming this flap, one of the vertical incisions was made just beyond the bridge of the nose rather than exactly in the middle line, not to gain more flap, but to make the subsequent scar less unsightly. The flap fell easily into its place, without traction or constriction of the pedicle, and, as is seen by referring to the diagram, Fig. 2, formed more than one-half of the new eyelid. The remainder of the eyelid and the wound on the cheek were filled up by a flap taken from the forehead, irregularly elliptical in form and of large size. This is marked "*b*" in the diagram; it was four and a half inches in length, one and three quarters in width at its widest part, and, like the other, had a pedicle one inch in width. In adjusting it, the pedicle, which might with advantage have been wider, but could not, was more twisted than the other, still it came easily into place, and without any undue constriction an arterial branch could be felt pulsating in it; the skin of which it was composed was fairly peppered with small-pox pits or scars, but in dissecting it off I did not notice any deep change in structure or any firmer adherence to parts beneath than in the other flap.

These flaps filled up the deficiency with great exactness, and after waiting a few minutes for the bleeding, which was slight, to subside, were carefully and minutely adjusted with points of interrupted suture, forty-eight in number, for which purpose black silk was used; there was not the slightest strain anywhere. I consider the use of *black* silk for sutures in these operations, which I learned from Professor Knapp, as a decided practical improvement, and as this is a department of surgery where attention to minutiae is preëminently important, I take the liberty of calling the attention of operators to the point. The dressing applied was simply a perforated oiled piece of linen and picked lint.

The patient bore this operation, which was necessarily a protracted and painful one, with perfect fortitude, only interrupting us once in the middle of the proceeding to ask for a drink of whiskey, which eminently reasonable request was of course granted. His pulse was not affected, nor the action of the heart hurried, during the three hours he was on the table.

The growth, after its removal, was examined by Dr. S. G. Perry, of this place, an accomplished microscopist, and found to possess all the characteristics of epithelial cancer.

In two days the flap from the forehead began to show evidences of deficient vitality, and in a week had nearly all sloughed away except the pedicle; but that from the nose, constituting most of the lower lid, did well, and by the process of cicatrization and contraction the result was very admirable, almost as good as I had anticipated if both flaps had lived. May 15th he was discharged from the hospital, with



Fig. 3.

the wound nearly healed. October 2d I saw him; there has been some contraction of the scar, and the lower lid is dragged slightly down, preventing complete closure of the eye, but he suffers no inconvenience therefrom, and there is no lachrymation. Fig. 3, from a drawing taken October 11th, shows his condition at that time. It was my intention to have had a photograph taken for this purpose, but his heart-disease became so much worse that he could not walk to the photographer's; but the drawing is an accurate representation of his appearance.

From the latter part of November the heart-disease confined him entirely to the house ; for many nights he was unable to lie down at all, and could only snatch a few minutes of sleep while sitting in a chair. His legs, face, and upper extremities began to swell ; in particular, his left arm and hand were very much distended and of a purple color ; he had troublesome expectoration of frothy, watery material, and almost complete failure of appetite. During his paroxysms of dyspnœa it was curious to see the deep purple color of the cicatrices contrasted with the general pallor of his countenance.

There are many points of interest in this case ; it suggests the inquiry whether the presence of heart-disease, even when strongly marked, is necessarily a contraindication to the administration of an anæsthetic. I believe it is not. I have searched all the authorities at my disposal on this point, but do not find anything very definite on the subject. Without citing any of them, however, I may say that most of those who take notice of it at all agree with the opinion I have expressed. If an anæsthetic is administered in such a case, which should it be, chloroform or ether ? I answer, chloroform, for the following reasons : it is more quickly administered and more manageable ; it requires less of it to be given ; it produces a less violent and protracted stage of excitement. I have seen chloroform administered for the dyspnœa of heart-disease both by the stomach and by inhalation with decided benefit and without the least bad effect.

With regard to the sloughing of the forehead flap, we may enumerate at least three circumstances to account for it : the large size of the flap, and, perhaps, the disproportionately small size of its pedicle ; the

heart-disease affecting circulation and nutrition in all parts of the system ; and, the character of the integument used, it being pitted with small-pox. In my own mind I am inclined to give the predominance to the latter condition. Small-pox pits are undoubtedly examples of true scar-tissue, a tissue which is proverbially of low vitality, and therefore unfit for plastic operations, which demand the highest vitality in the tissue employed in making flaps, and demand the observance of every auxiliary to preserve that vitality and defend it from adverse influences.

Flaps of transplanted skin often slough in the best of circumstances, and with all the difficulties presented in this case, it can be no wonder that what must be considered relatively a very large one should have done so.

Furthermore, we learn from this case how much nature alone can do to remedy what appears at first and to short-sighted observation an irreparable loss in such a case ; so great, indeed, is this, that it has led some men of good judgment and large experience to express a doubt whether it would not be safe and justifiable in the removal of such growths to trust the case to the granulating and cicatrizing process entirely, and not attempt any plastic operation at all. With such opinions I cannot agree, particularly where the tissue of the eyelids is involved. Here the nice art of the plastic surgeon can do and has done wondrous things.

As there can be no rules laid down in this department of surgery which will be a sufficient guide for every case, therefore the records of cases themselves will always furnish the best hints from which operators

may adopt that which is suitable to their necessities ; and as Professor Knapp has laid us under great obligations by the record of several very remarkable and ingenious operations of this sort in these "Archives," I judged this to be the best possible place for the publication of the present case.

After some weeks of severe suffering, poor Rafferty died, December 22d, 1871. His wife refused to allow a post-mortem examination to be made.

EPICANTHUS AND ITS TREATMENT.

BY H. KNAPP.

SINCE F. A. VON AMMON first gave the name of *epicanthus*, and described (Zeitschrift für Ophthalmologie, Vol. I., page 533, etc., 1831) the peculiar redundancy of skin which, in the shape of a semilunar fold, stretches from above downward in the region of the lachrymal sac, so as to cover, more or less, the inner canthus and caruncle, this affection has been generally admitted into the classification of eye diseases. The literature on the subject, however, has remained remarkably scant; and if we consult the leading text-books of ophthalmology, we find so little information in regard to its proper mode of treatment that the publication of new experience can scarcely fail to be welcome.

It is a fact that the congenital deformity known under the name of epicanthus generally diminishes with advancing years. Most oculists, therefore, are unwilling to operate for it on children, or to interfere with it at all. Having seen, however, cases in adults where the deformity was still very conspicuous, I have made it a rule to remove the anomaly in all instances in which its degree is so marked as to cause notable disfigurement. I think operative interference is especially indicated when epicanthus is complicated with ptosis and squint. Children thus affected have not only a very unnatural expression of countenance, but acquire a habit of looking

with one eye only, keeping the other shut, and holding the head backward toward the side of the closed eye.

The *operations* advised for epicanthus are *twofold*: *first, to attack the redundant fold of skin itself; and, secondly, to excise a piece of skin from the back of the nose*—Rhinorrhaphy.

I have performed, at Heidelberg and in New York, a considerable number of operations for epicanthus, with varying results. It seemed to me at first that the incision or excision of the integumental fold was so natural and simple a procedure as to deserve trial. I incised the fold of skin horizontally at the level of the inner canthus, or excised a small wedge-shaped piece of it, and stitched the edges together in the manner practised in the operation for blepharo-phimosis, commonly called canthoplasty. The results looked favorable at first, but proved unsatisfactory on account of more or less extensive recurrences of the deformity.

In other cases I excised the fold of skin from above downward, and united the edges of the wound with sutures. The deformity was removed, but in a few weeks it began to re-establish itself. In some of these operations I had noticed that the redundant fold of skin was raised and supported by a dense aponeurotic subcutaneous cord of connective tissue. Thinking this cord to be the primary cause of the failure of many operations, on account of the relapses, I excised it clean to the periosteum, and united the wound by ordinary sutures, as before. By this method I now and then obtained a satisfactory result; but in the majority of cases the deformity reappeared, and in some instances

in a marked degree. This will not be very astonishing, if we remember that the contraction of cicatrices is always greatest in the direction of their longest diameter—a fact which throws, *a priori*, an unfavorable light upon all operations for epicanthus, in which a vertical fold of skin, with or without subcutaneous fibrous tissue, is removed. The other method, by excising a wedge-shaped piece from the centre of the epicanthus, fails also on account of the subsequent contraction of the scar. Analogous examples are the reunions of divided commissures, webbed fingers, etc. But let me not forget to mention that each one of the described operative procedures sometimes yielded a satisfactory result. As, however, the relapses were too frequent, I have of late not practised them.

It was only while arranging my material for this paper that I looked up the literature on the subject.

In a short article by M. J. A. Schön, of Hamburg, in Von Ammon's *Zeitsch. f. Ophth.*, II., p. 120–122, 1832, I find a passage so much in accordance with my observations that I cannot refrain from transcribing it:—

Schön saw an operation for epicanthus performed, in 1823, by the elder Von Gräfe. The operator raised a fold of the epicanthus with a pair of forceps, and excised with scissors a triangular piece of it, and cut deeply into the underlying tissue toward the bone of the nose, near the inner canthus, to the extent of about one line. The wound was covered with a small dossil of lint, besmeared with cerate. Schön says that he described this procedure from memory, and could not vouch for its accuracy, nor did he see the result of the operation; but mentions that V. Gräfe, Sen., stated to have successfully operated several times according to this method. Nearly the same operation, only less extensively, was performed by Von Ammon on a boy. He

only divided the fold of skin with a knife, and tried to prevent reunion by filling the wound with fine lint, but was unsuccessful in the attempt. Then he made a longitudinal incision through the transverse section, pared the flaps from their summits to their base, removing so much of them as to produce a regular quadrangular defect in the skin. But in two weeks the integumental fold was re-established. Now he performed, with the most brilliant result, an operation invented by him, and styled "*rhinorrhaphy*," consisting in the excision of an oval piece of skin, more than an inch in length, from the root of the nose.

Schön concludes by stating that this operation seems to him greatly superior to that of Von Gräfe, Sen.

I have repeatedly performed Von Ammon's *rhinorrhaphy*. The epicanthus was always cured, but, in the majority of cases, not without an ugly scar on the nose. In some cases the cause of the scar was carelessness in the after-treatment, the children hurting themselves on hard objects, by which the wounds disunited. In others the middle sutures gave way without any apparent imprudence. It seemed to me that the aponeurotic condition of the subcutaneous tissue in these cases produced too great a traction on the wound. I have always employed the ordinary suture, with China bead silk, never the twisted suture with hare-lip pins.

Some months ago I operated on a typical case of epicanthus. As it presented all the features of this affection, and was a perfect success, I may be allowed to relate its history :

A little girl, C. A., of New York, was brought, when two years old, to the late Professor A. Von Gräfe, in Berlin. Though the parents had made the long journey, he positively refused to operate on the child, or do

anything for it at that time, believing that the deformity would disappear when the child had reached about her sixth year. Two years subsequently she was brought to me. There was complete ptosis of both eyes, a marked bilateral epicanthus, and divergent strabismus. The child had the habit of opening one eye only at a time, by forcibly raising the brow while the head was thrown back, and inclined to the opposite side. Half the pupil of one eye was thus uncovered. The child used both eyes alternately. The eyes themselves were healthy. The disfigurement was so great that I found it quite natural that the parents consulted "almost everybody." My advice was to have the ptosis and squint removed without delay, in order to give the child the chance of obtaining binocular vision; for which, I feel confident, there is a greater probability when the operation for strabismus is performed in early youth than later in life. As the parents told me that the epicanthus had not noticeably diminished, I advised them to have it also removed, but some time after the other operations, rather than have the necessary five operations done at the same time. The parents seemed to agree with my views, and concluded to have the child operated on in the manner I had proposed. But occasional sickness of the child and other disturbances in the family caused a delay of the operation for two years, during which time the child developed well; but the condition of her eyes underwent no change. When she was six years old, I operated on both upper eyelids for ptosis, and performed tenotomy of one external rectus muscle. The ptosis operation—excision of an oval piece of skin and

muscle, and uniting the wound by sutures—answered the purpose perfectly. The eyelids opened by contraction of the frontal muscle, over which the child had a great command, so as to uncover nearly the whole pupil without throwing her head back. Before the operation, the constant efforts to raise the upper lids had caused the eyebrows to assume a higher position than natural; and as the centre of each brow was higher than its ends, the brows had unpleasant angular curves. This circumstance, together with the increased space between the brow and the free edge of the upper lids, added to the strange appearance of the child's countenance. Both peculiarities were removed by the ptosis operation. The eyebrows came down, the notch in their centre disappeared, and the free edge of the upper lids, which before always showed a convex outline, now was nicely curved, with the concavity downward, when the child raised the lids. The closure of the palpebral fissure was complete and easy. The tenotomy of the external rectus of one eye had not removed the squint entirely. Furthermore, the child did not lose her habit to use both eyes alternately instead of simultaneously, and would frequently squint upward with the operated eye when the other was directed toward the object of fixation.

Four months ago, that is, nine months after the first operation, I performed a tenotomy of the other external rectus, which removed the slight degree of divergent squint left after the first operation. At the same time I performed rhinorrhaphy. A rhomboidal piece of skin on the root of the nose was circumscribed and excised. It was over an inch in length, and nearly two-thirds of an

inch in width at its broadest part. The skin of both sides was carefully undermined, in long strokes, with a very sharp knife. When the bleeding had subsided, the wound was united by eight ordinary sutures with fine China bead silk. I was scrupulously careful not to bruise the edges of the wound, and to unite them as perfectly as possible. The region of the wound was strapped with court-plaster, to relieve the stretching. No bandage was applied. The appearance of the wound and eyes looked satisfactory in the highest degree. The epicanthus had completely vanished. The child was watched unremittingly, day and night, lest by rubbing or a hurt the union of the wound be disturbed. Nothing of the kind happened. No inflammation set in. Four sutures were removed on the sixth day, and the other four on the eighth. The union *per primam* was perfect. That it had not been obtained without lateral stretching was visible during the following weeks by the condition of the newly-formed tissue between the edges of the wound. This tissue had a breadth of one line at its centre, where the traction had been greatest, and narrowed towards both ends. The elastic newly-formed tissue which was interposed between the edges of the wound, and united them, yielded to the traction in a certain degree, but did not rupture. The surface of this interposed tissue—the cicatrix—was perfectly smooth, and at the level of the surrounding skin. Its color was faintly redder. The scar was hardly perceptible.

The epicanthus did not return, the divergent strabismus was removed, but the child for some time showed a

tendency occasionally to squint upward with the eye first operated on. More and more, however, the simultaneous fixation with both eyes became predominant, and at this day it is almost fully established. The eyelids are easily raised, and the reclination of the head has also disappeared.

In this case, which presented about all the complications connected with epicanthus, a complete success of the different operations was obtained. Accuracy and neatness of performance, and great care during the after-treatment, seem to be essential to attain union by first intention in Von Ammon's rhinorrhaphy. Its originator used hare-lip needles to unite the wound. I prefer, in delicate plastic operations, the ordinary sutures, carefully tied and closely set.

After many trials, I purpose to abide by Von Ammon's method, with the modifications described in the foregoing case. SICHEL (*Annales d'oculistique*, t. xxix., p. 211) recommends to pass some threads under the raised skin on the back of the nose before excising the skin with scissors. L. WECKER—*Traité des Mal. des Yeux*, t. i., p. 621—fears that the operator in this case may be liable to sever one or several threads while excising the piece of skin. Wecker, therefore, recommends to pass threaded curved needles only half way through, under the raised fold of skin, excise the skin with scissors, then draw the needles completely through both flaps, and tie the threads. This method is simple, and may answer in low degrees of epicanthus; in higher degrees, however, I should not recommend it, fearing that union by first intention may not be ob-

tained. I must not omit to mention that for high degrees of epicanthus simple excision of an oblong piece of skin from the root of the nose, without applying any sutures at all, has been proposed, with a view that the more extensive contraction of the cicatrix after the healing by suppuration removes the epicanthus more efficiently. I cannot agree with this proposal, as the cicatrices I saw when primary union was not obtained were rather bad-looking.

To conclude with *summing up* the results of my experience, I may state as follows:—

Epicanthus of a higher degree, which does not diminish or disappear during the first four or five years of life, is not likely to do so later in life, and should be removed by operation.

The operative procedures which attack the integumental fold itself are apt to fail, as the subsequent cicatricial contraction frequently produces relapses.

Von Ammon's rhinorrhaphy—removal of a rhomboidal piece of skin from the root of the nose, and uniting the edges with sutures—is a reliable method for the removal of epicanthus.

We must endeavor to obtain union by first intention, on account of the disfiguring scars which are left on the back of the nose when suppuration ensues.

To obtain primary union, the excision of skin should be done carefully, the adjacent skin undermined without any bruising, and the wound well united by delicate and closely set sutures. Strapping with court-plaster may help to diminish the tension of the skin.

During the first days after the operation great care

is to be recommended, lest by restlessness of the patient, or some accident, a separation of the wound ensue, the consequence of which would be a bad-looking scar.

NEW YORK, *September 1st*, 1872.

CLINICAL CONTRIBUTIONS TO OPHTHALMOLOGY.

BY DR. LANDESBERG, OF ELBERFELD.

(Translated by Dr. E. Gruening.)

I. PERFORATING SCLERAL WOUND. COMPLETE RECOVERY.

THE ophthalmological market is so abundantly supplied with cases of scleral injury, that in adding to the stock I fear to weary the patience of my colleagues. If, however, regardless of this reflection, I publish the following case, I appeal to its heading for an apology.

In our industrial valley of the Wupper, we have an ample opportunity of treating divers injuries of the eye, and observing their course. Unfortunately, in the vast majority of these cases our curative attempts prove futile. Even if we except neglected cases coming under our care after much delay, and exclusively consider perforating wounds, under immediate and skilled attendance, we obtain no better statistics. Vision remains more or less extinct, the globe begins to shrink, and we are glad if cyclitis does not supervene. Occasionally we are cheered by a favorable result, but even then have no certainty of its permanence. We discharge the patient with comparatively good sight, while the

lurking enemy is perhaps at work to destroy irretrievably the gain of a hard struggle.*

For this reason I think it justifiable to publish those cases in which, despite the severity of the injury, sight is not only recovered, but also permanently retained.

In the night of the first and second of November, 1868, E. B. was maliciously cut in the face with a sharp knife. Being summoned immediately after the infliction of the wound, I found the patient in a state of syncope from profuse hemorrhage. I then noted the following injuries :—

1. In the left upper lid an incised wound, $1\frac{1}{2}$ " in length, running from above downward and inward, and cutting through the whole thickness of the lid.

2. In the eyeball a lacerated wound, beginning at the limbus conjunctivæ and extending backward. It measures 2" in width, and 3" to 4" in length, has jagged edges, and perforates all the coats of the

* I beg leave to illustrate these remarks by two pertinent cases of my observation :—

I. On March 6, 1871, I was called to see a little boy, aged three years, who had wounded his left eye with a penknife. Examining the patient shortly after the occurrence of the accident, I found the eye in the following condition :—

Left eye. Incised scleral wound, beginning a little above the insertion of the inferior rectus, running in a straight line to the limbus conjunctivæ, and touching the lower periphery of the cornea. Iris prolapsed; anterior chamber filled with blood; whether the lens was intact I could not learn; eyeball very soft.

I snipped the prolapsed iris, instilled atropine, and applied a pressure bandage.

The wound healed without the slightest reaction. On April 4, I noted: Wound cicatrized; anterior chamber deep; cornea and other refractive media perfectly clear; fundus normal. After closing the right eye the patient walks about and recognizes the smallest objects.

I discharged the patient, but kept him under observation for several months, during which time I was greatly pleased with the favorable condition of the eye.

On December 11th, the patient was brought to me in the following state :—

Left eye. Ocular conjunctiva chemotic; anterior chamber very shallow; iris swollen and nodular; almost complete circular synechia; secondary cataract;

globe. The iris and vitreous body are wedged in the gap. No anterior chamber. Behind the cornea a mass of blood. Perception of light extinct. Ocular conjunctiva and lower lid very ecchymotic.

3. A wound extending obliquely from the inner angle of the eye along the left wing of the nose and the upper lip, cutting through the whole thickness of both, and causing a considerable gaping of the cleft parts.

The stab had been inflicted with great force from above downward, its lower limit being marked by a deep cut in the breast of the coat.

I fulfilled all the indications at once, applied a pressure bandage, and put the patient to bed.

The following day the reaction was very considerable. Conjunctiva greatly chemotic. Eyeball soft and tender. Scleral wound gaping. Vitreous oozing from the wound. On the whole, the eye bears the impress of incipient panophthalmitis.

intraocular pressure increased; eyeball somewhat atrophic; perception of light extinct.

The present affection began about one week previously, without an assignable cause.

I used antiphlogistic means and succeeded in suppressing the inflammatory symptoms.

II. On October 17, 1871, I was summoned to see C. S., a little boy, aged two and a half years. I found the patient in the following condition:—

Right eye. Lacerated scleral wound, 6 mm. in length, beginning near the limbus conjunctivæ in the upper and outer quadrant, and running obliquely downward; prolapsus iridis; cataracta traumatica.

The little boy had been injured by falling and striking his face against a stone, three hours before I saw him.

The inflammatory reaction, though very considerable, was successfully combatted by an energetically antiphlogistic course of treatment. In the third week, with a view of guarding against the injurious swelling of the corticalis, I performed iridectomy. This proved a valuable auxiliary in accelerating absorption.

When all inflammatory symptoms had subsided, I discharged the patient—Dec. 9.

During the following three months I examined the patient from time to time, and was well pleased with the result.

The corticalis was completely absorbed; vitreous body intact; fundus normal; vision good.

About two weeks ago I noticed a diminution of sight. Examining the right eye with the ophthalmoscope, I found floating opacities in the vitreous and an incipient retinal detachment in the upper and inner quadrant.

The inflammatory symptoms were very severe until the eleventh day; from that day the eye improved slowly but steadily. The scleral wound remained gaping a long time, the iris and vitreous acting as a plug, and preventing a further prolapse. Gradually the intraocular pressure increased and the anterior chamber filled. The extravasated blood disappeared, and the lens was found intact. An intraocular hemorrhage had undoubtedly also taken place, as quantitative perception of light did not return over the whole extent of the field of vision until the third week.

The case progressed very favorably. After abscission of the prolapsed iris, the scleral wound closed with a firm cicatrix. The pupil, oval in shape, and drawn toward the nasal side, was perfectly movable and free from synechiæ. No trace of a deposit on the anterior capsule of the lens.

On January 13, 1869, I discharged the patient cured, and the examination showed:—

$$\text{R. Hm } \frac{1}{8} \text{ S} = \frac{7}{20}$$

$$\text{L. Hm } \frac{1}{7} \text{ S} = \frac{6}{20}$$

Reads Snellen II. with + 6 at 7'' with either eye.

L. Refractive media clear and transparent. Not the slightest trace of opacity in the vitreous. Scleral wound, firmly cicatrized. Shape and resistance of eyeball normal. Fundus and visual field intact.

I re-examined the patient twenty-one months after his discharge, and found the eye still in the same condition.

II. GLAUCOMA FULMINANS. RECOVERY WITH GOOD SIGHT AND COMPLETE FIELD OF VISION.

IN the Archives of Ophthalmology, Vol. VIII., part II., Von Graefe published several cases of glaucoma fulminans, and reported his observations, as regards the influence of both early and delayed iridectomy upon the

recovery of sight. Subsequently this subject was almost completely dropped, and no pertinent cases appeared in our special literature. Yet I consider it both interesting and instructive to obtain further proofs *concerning the influence of iridectomy upon the restoration of sight, and the visual field in glaucoma fulminans*, and believe that this form of glaucoma, if accurately observed in its various stages, is best adapted to furnish us a key to many as yet unsolved problems. As an addition to Von Graefe's series of observations, I publish the following case :—

I was consulted by Mrs. L. A., aged 58 years, who had lost the sight of both eyes. On examination I found both eyes in the following condition :—Considerable chemosis of ocular conjunctiva. Eye-ball exceedingly hard. Pupil moderately dilated, not sensitive to even the strongest light. Anterior chamber very shallow. Cornea hazy, its sensibility diminished. With oblique illumination both corneæ show opaque radiating stripes ; these are very dense in the right cornea, and alternate with fleecy patches. Ciliary neurosis intense. Other symptoms of irritation very severe. *Right eye*, quantitative perception of light. *Left eye*, no perception of light. Ophthalmoscopic examination impossible.

The patient states that the prodromic symptoms appeared in the right eye six months ago, up to which time she had enjoyed good sight. In the spring of 1868, the right eye became slightly inflamed, and its sight temporarily obscured. Similar attacks, varying in duration and intensity, followed at irregular intervals. The patient ascribed these symptoms to her usual megrim, and consulted no physician. The last attack, on January 18, 1869, was exceedingly severe. Sight diminished rapidly, and on the next day, when I first saw the patient, was reduced to quantitative perception of light. On the morning of that day the left eye, which until then had remained intact, grew exceedingly painful, and its sight vanished so rapidly as to become extinct in the course of the forenoon.

Six hours later I performed iridectomy on the left eye, and the following day on the right.

In both eyes the wound healed but slowly, and symptoms of irritation of great intensity continued a long time. Intraocular pressure remained high, the wounds closed tardily, and in the right eye with a cystoid scar.

The final result, however, was excellent.

On February 22, the patient was discharged in the following condition:—

Tension normal in either eye. No trace of irritation. *Left eye*: cornea and the other refractive media perfectly clear. *Right eye*: cornea in its upper periphery studded with opaque specks. Aqueous humor and vitreous body clear. Anterior chamber restored.

In both eyes: Excavatio papillæ nervi optici.

$$\left. \begin{array}{l} \text{R. S. } \frac{2}{20} \\ \text{L. S. } \frac{2}{3} \end{array} \right\} \text{Hm } \frac{1}{16} \text{ either eye.}$$

With + 10 R. Jaeg. 7. L. Jaeg. 2.

R. Field of vision contracted in the upper and inner quadrant.

L. Field of vision complete.

Subsequently the sight of the right eye improved to $\frac{2}{7}$, but after some time grew considerably worse again.

On March 3, 1870, the examination showed: R. S. $\frac{1}{20}$, with + 10 Jaeg. 13. Intraocular pressure increased beyond the physiological range. Contraction of field of vision, as above.

The last examination, on June 16, 1871, showed: R. S. = Fingers at 15'. Tension decidedly increased. Incipient cataract.

No change in the condition of the left eye.

III. TWO CASES OF RIBBON-SHAPED CORNEAL OPACITY, COMPLICATED WITH INTRAOCULAR CHANGES.

In the Archives of Ophthalmology, Vol. xv., part III. Von Graefe first directed the attention of Ophthalmologists to a peculiar form of corneal opacity, frequently

coincident with glaucoma. He describes this affection most accurately, and terms it *Ribbon-shaped opacity of the cornea*. He states that in the course of this affection the uveal tract becomes involved. The participation of the inner coats of the eye manifests itself either as glaucoma simplex or as secondary glaucoma, with all its accompanying symptoms. Further observations and explanations of this peculiar and most interesting form of disease have, as far as I know, not yet appeared in ophthalmological literature.*

For this reason, I have no hesitation in publishing *two cases of ribbon-shaped Keratitis, associated with Glaucoma*. The first case is the choicest type illustrative of the pathogenesis of secondary glaucoma. The case is quite analogous to Von Graefe's cases, and (if we are allowed to draw conclusions from a single case) corroborates and at the same time modifies his views, as to the effect of iridectomy upon the further progress of the corneal affection. The second case is interesting from another point of view. It touches upon the question of hemorrhagic glaucoma, and the utility of iridectomy in this affection.

A. Ribbon-shaped Keratitis, complicated with secondary Glaucoma.

C. St., æt. 60, consulted me on November 24, 1868. The patient, a very intelligent and accurate observer, keeps a detailed account of

* Hirschberg describes a case of ribbon-shaped corneal opacity (Berl. Klin. Wochenschrift, p. 551), and explains it as sympathetic ophthalmia. Clarke describes three cases of symmetrical ribbon-shaped opacities. Neither mentions complications. (Vide Jahresbericht über die Leistungen und Fortschritte der Ophthalmologie. I. Jahrgang, p. 287.)

his affection, and knows the exact dates of its development. He states, that eighteen months ago he first noticed a diminution of the sight of his right eye. Naturally timid, he did not hesitate to seek medical advice at once. He received no local treatment. *Ut aliquid fiat*, blue protectors and a mild derivans were prescribed. In the meantime, the disease progressed slowly, but steadily. The sight grew worse and worse, and periodically symptoms of irritation and dazzling, attended with ciliary neurosis, appeared. When finally the left eye became implicated, the patient placed himself under my care.

I may frankly confess that I was greatly puzzled in diagnosticating the nature of a corneal affection of so strange an aspect. I could not recall an analogous case to guide me. Aside from other considerations, the whole appearance and shape of this opacity, which had attained its culminating point in the right eye and was developing in the left, led me to exclude a malignant neoplasm. Von Graefe's observations on this affection were published one year later, and so well did his description accord with what I had seen, that in perusing the masterly essay, I at once obtained a clear view of my own case.

The condition of my patient was as follows :

Right eye. Wide, ribbon-shaped, and continuous opacity corresponding to the palpebral fissure, and extending transversely over the whole cornea. The opacity is reddish-brown, and has an equal degree of color intensity from the margins to the centre of the cornea. The centre itself appears whitish-gray, as if a metallic salt had been precipitated there.* With oblique illumination, the epithelium seems to consist of minute dots of brown color. The ribbon-shaped opacity has a sharply-defined boundary line above and below. The upper and lower segments of the cornea are perfectly normal. Subconjunctival injection. Upon pressure with probe, right ciliary region more sensitive than left. Intolerance of oblique light. Tension normal. Sight greatly reduced. Patient counts fingers at the distance of 5'. With dilated pupil, sight $\frac{9}{40}$; with + 10 Snellen II $\frac{1}{2}$ at 10". Iris reacts very sluggishly to atropine. After several instillations repeated at

* At first sight I asked the patient whether he had made use of a powder or a salve; this he denied.

intervals of ten minutes, the pupil dilates sufficiently to reach the clear parts of the cornea. Ophthalmoscopic examination impossible.

The left eye exhibits the first stage of the affection. Near the inner and outer margins of the cornea we find a narrow opaque stripe of a slightly brown shade. The opacity has the appearance of a thin stripe of brown color laid quite superficially on either side of the cornea with the most delicate touch of the brush. The centre of the cornea is perfectly transparent. Iris clearly visible. Reflection of the cornea normal. The opacity is best seen with oblique illumination. No symptoms of irritation. Mydriasis after instillation of atropine complete. Fundus normal. Hm $\frac{1}{30}$, S= $\frac{9}{10}$. With $\times 10$ Snellen $1\frac{1}{2}$ at 6''.

In proposing to the patient to have an iridectomy performed on his right eye, I did not believe that this operation would influence the course of the peculiar corneal affection, but was guided by other considerations—viz., the great reduction of sight, the narrowness of the pupil, and the manifest hyperæmia of the iris. I wished to guard against a further participation of the iris, the formation of posterior synechiæ, and the supervention of the irido-chorioiditis. By the iridectomy I intended to better the sight and free the uveal tract from danger. I explained to the patient that the operation would most probably not stay the progress of the corneal affection.

The patient declined to be operated upon, and left me, saying he required time to consider the matter. On February 11, 1869, he presented himself again at my office. He had met with a sad disappointment. Under the care of a homeopathist, who had guaranteed a perfect cure, the pain had grown intolerable and the eye become blind. The fear of losing the other eye brought him back to me, with the determination to submit to whatever plan of treatment I should propose.

I found the right eye in the following condition: considerable degree of subconjunctival injection. Anterior chamber shallow. Eyeball very hard. Aqueous humor turbid. Several posterior synechiæ. Quantitative perception of light. Corneal opacity unchanged.

There were, in short, all the symptoms of secondary glaucoma.

The following day I performed a very broad iridectomy above, and injected morphia to combat the very violent ciliary neuralgia. One

day after the operation the tension of the eyeball had lessened. Recovery was tardy, owing to recurring inflammatory attacks and repeated hemorrhages into the anterior chamber. The final result was exceedingly favorable.

On April 23, when all the inflammatory symptoms had subsided, the patient was discharged. R. S= $\frac{6}{40}$. With + 10 Jaeg. 5.

The patient was re-examined on May 5. R. S= $\frac{10}{40}$. With + 10 Jaeg. 3.—L. S= $\frac{10}{12}$. Hm. $\frac{1}{4}$. With + 10, Jaeg. 1.

The eyes remained a long time in this satisfactory condition. In the right eye the inflammatory symptoms did not recur; in the left eye the disease did not advance, and the patient was able to resume and pursue his business. During the subsequent two years I kept the patient under observation, and noted the stability of his condition. One year later, when I was preparing this paper for publication, I looked the patient up. On the whole, he was satisfied with his condition, but complained that his right eye had of late become somewhat irritable. The annoyance resulting therefrom was but slight, and did not materially interfere with the proper discharge of his ordinary duties.

On examination I found the following:—In the left eye the disease had but slightly advanced. The opacity, though somewhat more intense than formerly, does not yet reach the centre of the cornea. Reaction of pupil perfectly normal. Iris clearly visible. Tension of eyeball normal. No irritability of the eye.

Right eye. Considerable advance of the corneal affection. The opacity has gained in width, upward and downward, leaving on either side a very narrow rim of clear corneal tissue. The aspect of the case corresponds to Von Graefe's, Fig. 3, Tab. 1, differing from the latter only as regards the extension upward. The opacity has a tendinous appearance, and is studded, especially near the inner and outer corneal margins, with fleecy spots. Tension normal. No irritability.

I had no opportunity of testing the sight accurately. With the right eye the patient read moderately large print.

b. Ribbon-shaped Keratitis complicated with Hemorrhagic Glaucoma.

S. D., æt. 55, strongly built and healthy-looking, consulted me on May 5, 1870, on account of an affection of his right eye. I noted the

following condition:—The right eye exhibits all the phenomena of subacute glaucoma. Increase of tension. Slight subconjunctival injection. Pupil moderately dilated, its reflex and consensual reactions sluggish. Anterior chamber shallow. Aqueous humor clear. Vitreous somewhat turbid. Fundus clearly discernible, with all its details. Excavatio papillæ nervi optici. Veins strongly injected and tortuous. Arterial pulsation easily produced by slight digital pressure upon the eyeball. *Peripherally above* (inverted image) *numerous hemorrhagic spots in retina*. Isolated patches of blood in the inner quadrant of the retina, and in the vicinity and on the inner side of the disc. Region of macula lutea perfectly free.

The cornea exhibits the characteristic appearance of that stage of ribbon-shaped keratitis in which the two legs of the opacity have not yet reached the corneal centre, and therefore form no continuous stripe. The opacity is brownish in color; corneal epithelium smooth and shining. With oblique illumination the brownish coloration seems to consist of minute granules. Iris normal in color and clearly visible; eye highly myopic in structure, with the correcting concave glass $\frac{1}{8} S = \frac{5}{30}$. The patient reads Jaeg. 10 with great difficulty and frequent intermissions. He says the letters dance before his eyes, sometimes appearing dim and blurred, at other times clear and distinct. The examination of the visual acuity is very trying to the patient. Field of vision, superficially examined, seems equally contracted on all sides excepting the lower and outer quadrant.

: *Left eye*. M. $\frac{1}{8} S = \frac{2}{7}$; fundus normal; cornea shows no trace of incipient ribbon-shaped keratitis.

The patient states that, though myopic, his eyes had always served him in very trying work, and never troubled him up to two years ago. At that time he noticed that the right eye became more easily fatigued than the left. It seemed to him that a slight fog was veiling the sight of the right eye. At first he attached little importance to this observation; but when, in the course of time, the sight continued to grow worse, and symptoms of dazzling appeared, he sought medical advice without obtaining relief. In January, 1870, ciliary neuralgia and slight obscurations of the visual field supervened. These symptoms lasted but a short time and disappeared spontaneously. The attacks recurred at

irregular intervals and with variable duration of the attending phenomena of irritation. At the time when the first attack appeared the patient was at sea, and therefore unable to consult a competent physician. The case was thus protracted until May 4, when a violent attack of ciliary neuralgia, attended with obscuration of the field of vision, supervened. The attack passed away, leaving the sight considerably impaired. The patient then sought my advice.

The next day I performed a broad iridectomy above.

The wound healed nicely within a few days. The inflammatory symptoms abated rapidly. One day after the operation the tension of the globe was normal and remained so; the anterior chamber was restored; the opacities of the vitreous disappeared; the hemorrhagic patches were gradually absorbed.

On May 26, R. M. $\frac{1}{6}$; S= $\frac{5}{20}$; Jaeg. 4, and some words of Jaeg. 3; aqueous humor, lens, and vitreous clear; optic disk pale, slightly excavated; veins and arteries normal; several hemorrhagic patches completely absorbed; the visual field is considerably contracted on the inner side.

I re-examined the patient on June 29, and obtained the same result. He pursues his ordinary business and is well satisfied with the condition of his eyes. With concave glass, $\frac{1}{10}$ for either eye, he works with ease.

The last examination I made on July 22, 1871:—

L., M. $\frac{1}{8}$; S= $\frac{5}{8}$; Jaeg. 1.

R., M. $\frac{1}{6}$; S= $\frac{5}{20}$; Jaeg. 3, fluently.

Tension of eyeball normal; ribbon-shaped opacity has not gained; excavation of disc very shallow; hemorrhagic patches in retina absorbed; here and there along the course of the vessels masses of pigment.

The eyes remained in a very satisfactory condition in spite of a persistent strain. The limitation of the visual field has somewhat diminished.

CLINICAL OBSERVATIONS.

By CHARLES J. KIPP, M.D.,

OF NEWARK, N. J.

I.—A CASE OF PERSISTENT HYALOID ARTERY IN BOTH EYES.

F. C., 60 years of age, came under my care on account of a small splinter of wood embedded in the ocular conjunctiva of the right eye. As the patient at the same time complained of impairment of sight, an ophthalmoscopic examination was made, which, in addition to some atrophy in the choroid of both eyes, revealed the following anomaly: In the right eye a dark thin cord, surrounded by a grayish translucent envelope, was seen to extend from the optic papilla straight forward as far as the centre of the vitreous. Its diameter was that of a primary branch of the central retinal vein. The anterior end of this cord was about three times as broad as its trunk, somewhat flattened laterally, and divided into three short branches, the free extremities of which were bulbous. Its other end formed immediately before the centre of the optic disc a small loop and then disappeared. The loop was of a light red color, whilst the straight portion appeared dark. *Pressure on the globe produced pulsation in the loop as well as in the retinal arteries.*

In the left eye an artery of about the diameter of a primary branch of the central retinal artery was seen to extend from the centre of the papilla to about the middle of the vitreous body in a slightly outward and upward direction, when it formed a loop, and then, winding itself in a double turn around its first portion, returned to the papilla, where it disappeared. It was of the same diameter throughout, of a light red color, and in fact presented all the characteristics of a retinal artery. Pulsation was likewise visible in it when pressure was exerted on the eyeball.

On looking over the literature of the subject, I find that only eight cases of persistent hyaloid artery have been put on record, but in

none the anomaly was observed in both eyes, as in the case above described.

II.—SYPHILITIC IRITIS WITH GELATINOUS EXUDATION.

C. G., 23 years of age, contracted a sore on his glans penis thirteen months before he consulted me with reference to his iritis. According to his statement, this sore healed rapidly under treatment. No enlargement of the inguinal glands was noticed at the time, and his health continued good till about nine months later, when he contracted what he called a gonorrhœa. For this he was treated by injection, which caused it speedily to disappear. About three months later, a copper-colored eruption made its appearance on face and body, and scabs were noticed in his hair. As his throat also became very sore, he consulted a physician, who pronounced his disease syphilis, and treated him accordingly. I first saw this patient about four months after the discharge from the urethra had made its appearance; the eruption was at that time still present on the forehead. Mucous patches were seen on the mucous membrane of mouth, and the inguinal glands were slightly enlarged.

On examining the eyes, the left was found to be normal. In the right eye was noticed slight peri-corneal injection. The pupil was irregularly contracted. The iris was slightly swollen throughout, and near the pupillary edge of its upper segment was seen a slightly prominent point, the color of which was, however, the same as the rest of the iris. The aqueous was perfectly clear. Leeches to the temple, instillation of atropine, and inunction of ungt. hydrarg. were at once ordered.

On the following day the pupil was slightly more dilated, except in its upper portion. The prominent point above mentioned presented more the usual appearance of a gummy tubercle of the iris. Next day a grayish translucent exudation was seen to cover the condyloma, and to extend somewhat downward. During the next two days the exudation rapidly increased in quantity, so that on the fifth day it filled the entire anterior chamber with the exception of its periphery, thus leaving a very narrow rim of the iris still visible. The exuded mass was of a grayish color, was semi-transparent, and so coherent that no part of it, even while the

absorption was going on, sank to the bottom of the chamber. In form it so closely resembled a lenticular disc, with a sharply defined edge, that it could readily have been mistaken for a dislocated lens in the anterior chamber. After remaining in this condition for two days, the disc gradually diminished in size, and on the sixteenth day after the first appearance of the gummy tubercle, the exudation had completely disappeared. The pupil was now perfectly black, nearly circular, and well dilated; the condyloma had been absorbed, and its site was indicated only by a yellowish discoloration of the iris, and a firm posterior synechia. Frequent instillation of a solution of sulphate of atropine, and inunction of ungt. hydrarg., until tenderness of gums was developed, constituted the treatment.

The points of interest in this case are: 1, the primary lesion; 2, the peculiar exudation.

With regard to the first, there can, I think, be no doubt that the ulcer contracted first was a simple soft chancre, and that the gonorrhœa contracted nine months later was caused by a hard chancre in the urethra. The fact that secondary symptoms rarely appear later than six months after the primary lesion, and generally within three months after infection, taken in consideration with the history of this case, leave, I presume, but little room for doubt as to the correctness of this assumption.

Exudations of the above described character are probably not very infrequently seen in cases of iritis, as I myself remember having observed a similar exudation in a case of traumatic iritis, which at the first glance made me suppose that I was dealing with a dislocated lens. But as its occurrence in syphilitic iritis has, so far as I know, only been mentioned by Gunning, I have thought it worth while to bring it to the notice of the

profession. From close and frequent observation, I am quite certain that the exudation took place from the tubercle, for there it first made its appearance, and from there it spread in all directions, the whole being apparently one coherent mass.

REPORT ON SIXTY-FOUR CATARACT EX-
TRACTIONS ACCORDING TO THE
METHOD OF VON GRAEFE,

*Performed at the Massachusetts Charitable Eye and
Ear Infirmary, Boston, in the Year 1872, by the
Surgeons of the Infirmary.**

COMPILED BY

DR. HASKET DERBY, BOSTON.

THE amount of vision obtained has been, as far as possible, recorded. But it must be remembered that many of our patients come from a great distance, and are not in possession of the means to enable them to make a second visit to the city. The vision stated in the table is, therefore, in many cases that ascertained at the period of discharge, and may reasonably be supposed to have subsequently improved.

All our patients belong to the poorer classes, many of them being in an extremely destitute condition, and enabled to visit the Infirmary only by the charity of friends. It would be unfair, therefore, to institute a comparison between our figures and those of ophthalmic hospitals which contain private rooms designed to be occupied by the wealthy, whose superior health and greater powers of endurance are well known to furnish more favorable operative statistics. Could the surgeons of the Infirmary have included in this table the results of their private practice during the past twelve months, the percentage of success would doubtless have been materially increased.

* Drs. Gustavus Hay, Hasket Derby, Henry L. Shaw, Francis P. Sprague, B. Joy Jeffries, Robert Willard.

ANALYSIS OF CASES OF CATARACT OPERATED UPON BY THE
METHOD OF VON GRAEFE.

NO.	SEX.	AGE.	DATE.	OPERATION.	REMARKS.	DURATION OF TREATMENT.	RESULT.
1	male.	85	Oct. 12, '71.		Much inflammation, causing closure of pupil. Iridectomy five months later.	19 days.	$v = \frac{16}{100}$.
2	male.	80	Oct. 10, '71.	Normal.	Irido-choroiditis one week later.	21 days.	counts fingers.
3	male.	36	Oct. 20, '71.	Normal.	Did extremely well until the patient went out, contrary to orders. Severe inflammation and bleeding into anterior chamber ensued with immediate loss of vision.	24 days.	$v = 0$.
4	male.	40	Oct. 24, '71.	Normal.		21 days.	$v = \frac{30}{40}$.
5	female.	50	Oct. 31, '71.	Normal.		17 days.	$v = \frac{30}{60}$.
6	female.	50	Nov. 6, '71.	Normal.		18 days.	$v = \frac{30}{60}$.
7	male.	45	Nov. 3, '71.	Normal.	Did well till fourth day, when he left his bed and the ward, contrary to orders. Irido-choroiditis ensued.	27 days.	
8	male.	21	Nov. 13, '71.	Normal.		19 days.	$v = \frac{12}{40}$.

No.	SEX.	AGE.	DATE.	OPERATION.	REMARKS.	DURATION OF TREATMENT.	RESULT.
9	male.	65	Nov. 23, '71.	Normal.		28 days.	v = $\frac{3}{8}$.
10	male.	61	Dec. 4, '71.	Normal.	Some opaque capsule remained in pupil.	16 days.	v = $\frac{1}{8}$.
11	female.	62	Dec. 11, '71.	Normal.		31 days.	v = $\frac{1}{8}$.
12	male.	54	Dec. 7, '71.	Normal.	Hemorrhage into anterior chamber in consequence of blow on eye.	30 days.	v = $\frac{2}{10}$.
13	female.	68	Dec. 8, '71.		Patient very restless, wound remained open several days.	29 days.	v = $\frac{5}{40}$.
14	male.	71	Dec. 14, '71.	Normal.	Patient did well till an attack of pyemia supervened, which proved fatal.		
15	male.	22	Dec. 29, '71.	Normal.	Extensive sclerotic-choroiditis.	26 days.	
16	male.	41	Dec. 30, '71.	Normal.		18 days.	v = $\frac{1}{30}$.
17	male.	58	Jan. 2, '72.	Normal.	Some cortical substance remained in pupil.	17 days.	v = $\frac{1}{30}$.
18	female.	63	Jan. 4, '72.	Some vitreous lost.	Lens cretaceous and dislocated, much pain and inflammation ensued.	55 days.	v = 0.

19	male.	66	Jan. 5, '72.	Normal.		28 days.	v = $\frac{3}{80}$.
20	male.	63	Jan. 5, '72.	Normal.		4 days.	v = $\frac{1}{20}$.
21	female.	43	Jan. 11, '72.	Normal.	Some opaque capsule remained.	9 days.	Unrecorded.
22	male.	77	Jan. 11, '72.	Normal.		14 days.	v = $\frac{1}{60}$.
23	female.	63	Jan. 25, '72.	Normal.		26 days.	v = $\frac{1}{40}$.
24	male.	50	Feb. 1, '72.	Scoop used.	Capsule in pupil.	26 days.	v = $\frac{1}{60}$.
25	male.	63	Feb. 2, '72.	Normal.		18 days.	v = $\frac{3}{80}$.
26	male.	24	Feb. 13, '72.	Normal.	Much capsule in pupil; secondary operation June 3.	11 days.	v = $\frac{3}{80}$.
27	male.	52	Feb. 15, '72.	Normal.		15 days.	v = $\frac{2}{40}$.
28	male.	30	Feb. 26, '72.		Traumatic cataract, vision 19 days after operation $\frac{10}{60}$. Fundus subsequently became obscured through vitreous opacities which suddenly developed.	20 days.	
29	male.	24	Feb. 29, '72.		Traumatic cataract.	25 days.	v = $\frac{1}{60}$.

No.	SEX.	AGE.	DATE.	OPERATION.	REMARKS.	DURATION OF TREATMENT.	RESULT.
30	male.	60	Mar. 16, '72.	Normal.		20 days.	v = $\frac{15}{100}$.
31	male.	60	Apr. 2, '72.	Normal.		15 days.	v = $\frac{19}{100}$.
32	male.	42	Mar. 15, '72.	Normal.		11 days.	v = $\frac{10}{60}$.
33	male.	79	Mar. 18, '72.	Normal.	Patient reads Snellen I with + 2 $\frac{1}{2}$.	23 days.	v = $\frac{1}{10}$.
34	male.	70	Mar. 20, '72.	Normal.	Severe attack of colic the night after operation. Suppuration of cornea ensued.	28 days.	v = 0.
35	male.	68	Mar. 22, '72.	Normal.	The iris was cut with the knife and folded in, so it was grasped with the forceps. Wound healed a little slowly. Patient reads Snellen I at 4 inches with + 2 $\frac{1}{2}$.	30 days.	v = $\frac{10}{40}$.
36	male.	62	Mar. 29, '72.	Normal.		25 days.	v = $\frac{1}{2}$.
37	male.	80	Mar. 29, '72.	Normal.		28 days.	v = $\frac{1}{2}$.
38	female.	43	Apr. 2, '72.	Normal.	Cataract followed a blow on temple received two years before. It was found to be soft.	16 days.	v = $\frac{20}{40}$.

39	male.	20	Apr. 4, '72.		Cataract consequent on an explosion of gunpowder, and preceded by iritis. Projection upwards deficient.	22 days.	
40	female.	53	Apr. 9, '72.	Normal.		32 days.	$v = \frac{20}{80}$.
41	male.	71	Apr. 12, '72.	Normal.	Patient reads Snellen I with + 2½.	19 days.	$v = \frac{1}{1}$.
42	female.	64	Apr. 20, '72.	Normal.	A posterior polar cataract in a patient very feeble.	21 days.	$v = \frac{10}{100}$.
43	male.	55	Apr. 24, '72.		Cataract traumatic, preceded by iritis; and at time of operation partially absorbed.	23 days.	$v = \frac{9}{100}$.
44	female.	16	Apr. 27, '72.			16 days.	Unrecorded.
45	female.	62	May 3, '72.	Normal.		8 days.	$v = \frac{20}{40}$.
46	female.	72	May 2, '72.	Normal.	Iritis supervened, subsequently trachoma, necessitating long after-treatment. Patient reads Snellen 4½ with + 2.	64 days.	$v = \frac{15}{60}$.
47	female.	50	May 3, '72.	Normal.		22 days.	$v = \frac{20}{80}$.
48	female.	64	May 8, '72.	Normal.	Projection inwards, before operation, uncertain.	19 days.	$v = \frac{20}{80}$.

NO.	SEX.	AGE.	DATE.	OPERATION.	REMARKS.	DURATION OF TREATMENT.	RESULT.
49	female.	58	May 8, '72.	Normal.	Catarrhal ophthalmia supervened.	41 days.	v = $\frac{1}{4}$.
50	male.	67	May 21, '72.	Normal.	Irido-choroiditis ensued.	31 days.	
51	male.	80	May 27, '72.	Normal.		13 days.	v = $\frac{20}{100}$.
52	male.	73	May 27, '72.	Normal.		19 days.	Unrecorded.
53	male.	68	June 1, '72.			26 days.	v = $\frac{20}{30}$.
54	male.	57	June 3, '72.	Normal.	Blow on eye six days after operation ; much hemorrhage into anterior chamber.	24 days.	v = $\frac{15}{60}$.
55	male.	71	June 3, '72.	Normal.	Hemorrhage into anterior chamber and iritis, capsule in pupil ; secondary operation proposed.	39 days.	v = $\frac{5}{60}$.
56	female.	69	June 18, '72.	Normal.	An invalid for years, imbecile, requires to be constantly attended by daughter.	15 days.	v = $\frac{10}{100}$.
57	male.	74	June 28, '72.	Normal.	Some opaque capsule remained in pupil.	14 days.	v = $\frac{10}{40}$.

58	female.	65	July 11, '72.	Normal.	Cortical substance remaining in pupil. To return for secondary operation, but failed to do so.	18 days.	Unrecorded.
59	female.	64	July 13, '72.	Normal.		14 days.	v = $\frac{2\frac{5}{10}}{60}$.
60	male.	55	Aug. 6, '72.	Normal.		18 days.	v = $\frac{10}{100}$.
61	male.	63	Aug. 6, '72.	Normal.	Panophthalmitis Phth. Bulbi one eye from blow.	45 days.	v = 0.
62	female.	45	Aug. 10, '72.	Normal.	Large floating opacities found in vitreous.	17 days.	v = $\frac{1\frac{5}{10}}{200}$.
63	male.	23	Aug. 8, '72.		Iritis ensued.	24 days.	v = 0.
64	male.	74	Sept. 18, '72.		Pupil dilated slowly and slightly under atropine at time of preliminary examination. Probable entire corneal suppuration.	Still under treatment Oct. 1, 1872.	

REMARK.—It would seem from the foregoing table, that the average duration of after-treatment of these cases was 22.6 days; such, however, was not in reality the case, as many patients from remote parts of the country were kept in the Infirmary some time after they were in a condition to leave it, in order that an approximation might be made to the glasses they would ultimately require, and the expense of a second journey from home be avoided.

SUMMARY.

IN the majority of these cases the disease was senile, one case of posterior polar cataract occurring in a patient aged 64. Of the nine comparatively young patients, one suffered from a gunpowder explosion, one from a blow, one from a cut, and one was the subject of sclerotico-choroiditis posterior.

The patients who lost an eye were aged respectively 70, 63, 63, 36, and 23. Iritis and closure of pupil took place with one of 85. Irido-choroiditis with one of 80 and one of 67; hemorrhage into anterior chamber with one of 71, while one of 71 died of pyæmia.

During the healing process iritis happened 3 times, irido-choroiditis 3, vitreous opacities developed once, and in one case suppuration of the cornea supervened on an attack of colic. One patient went out prematurely, in disobedience to orders, and lost his eye.

Seven patients required a secondary operation:—

1	aged 85,	for consequences of iritis.
1	“ 71,	for capsular obstructions.
1	“ 61,	“ “
1	“ 57,	“ “
1	“ 50,	“ “
1	“ 24,	“ “
1	“ 21,	“ “

The results of vision are as follows. Each fraction is given as recorded, and, where not reduced to lowest terms, expresses of course the distance from the test in which the patient stood:—

$\frac{20}{20}$ 1	$\frac{10}{60}$ 3
$\frac{20}{30}$ 1	$\frac{15}{100}$ 1
$\frac{2}{3}$ 1	$\frac{1}{7}$ 1
$\frac{20}{40}$ 2	$\frac{10}{80}$ 4
$\frac{1}{2}$ 4	$\frac{5}{40}$ 1
$\frac{20}{50}$ 4	$\frac{10}{100}$ 4
$\frac{20}{60}$ 2	$\frac{5}{50}$ 1
$\frac{10}{30}$ 1	$\frac{1}{10}$ 1
$\frac{25}{60}$ 1	$\frac{9}{100}$ 1
$\frac{12}{40}$ 1	$\frac{15}{200}$ 1
$\frac{15}{50}$ 2	$\frac{5}{100}$ 1
$\frac{15}{60}$ 2	$\frac{1}{2}$ 1
$\frac{1}{4}$ 1	0.....5
$\frac{10}{40}$ 2	Died.....1
$\frac{20}{80}$ 1	—
$\frac{20}{100}$ 2	54

Of the remaining ten unrecorded cases, two failed to present themselves for a secondary operation, which would undoubtedly have restored them to useful vision. One had had an attack of irido-choroiditis, and when last heard from was in an unpromising condition. The remainder left the Infirmary before their vision could be noted, or the records relating to them filled out.

STATISTICAL REPORT OF 1652 CASES OF DISEASES OF THE EAR,

TREATED AT THE MASSACHUSETTS CHARITABLE EYE AND
EAR INFIRMARY DURING THE YEAR 1872.

By DRS. CL. J. BLAKE, AND H. L. SHAW,

OF BOSTON.

CLASSIFICATION.

Congenital malformation.....	2
Othæmatoma (traumatic, spurious).....	1
Fibrous tumor of lobe.....	1
Abscess of auricle.....	11
Obstruction of meatus from cerumen.....	246
Foreign bodies in meatus.....	16
Eczema of auricle and meatus.....	42
Exostosis of meatus.....	1
Wounds of meatus.....	2
Otalgia (auricle and meatus).....	9
Otitis externa circumscripta.....	19
Otititis externa diffusa.....	115
Myringomykosis aspergillina.....	1
Myringitis.....	36
Calcareous deposits in membrana tympani.....	10
Atrophy of membrana tympani.....	2
Rupture of “ “.....	3
Destruction of “ “.....	6
Perforation of “ “.....	62
Otitis media purulenta.....	287
Polypi accompanying otitis media purulenta.....	42
Polypoid granulations in middle ear and on membrana tympani..	71

Otitis media catarrhalis chronica.....	488
Otitis media catarrhalis acuta.....	107
Otitis media catarrhalis serosa	8
Otitis media hypertrophica.....	5
Otitis media hæmorrhagica.....	1
Otitis intermittens.....	2
Otitis interna s. labyrinthica.....	10
Otitis interna associated with cerebral disease.....	4
Otitis interna associated with injury to cranium.....	2
Otalgia neuralgica.....	16
Tinnitus aurium, associated with cerebral disease.....	6
Deaf-mutes.....	18
Unfit.....	19
Unrecorded.....	22

NOTES TO THE PRECEDING TABLE,

BY CL. J. BLAKE, M.D., OF BOSTON.*

The object of the following paper is to present such of the more interesting cases of disease of the ear as have been treated in the aural clinic during the past year. The fact that a large number of the patients come from distant parts of the State, renders it exceedingly difficult to keep an accurate record of results of treatment. This is to be regretted, as it diminishes the value of the statistics. The material afforded for observation, however, is so large, that individual cases of interest may readily be selected.

* The cases given in the table were treated in alternate quarters by Dr. Henry L. Shaw and myself, while the cases mentioned in the notes to the statistical report all occurred in my own clinic. I am greatly indebted to my colleague, Dr. Henry L. Shaw, for his observations in such cases mentioned in the above report as extended beyond my term of service.

CL. J. BLAKE.

Of the two cases of *congenital malformation*, the more interesting was that of the right ear in a girl three years of age, the left ear being perfectly normal, and the hearing good. In this case the long diameter of the auricle formed an angle of 45° with the vertical plane of the head; the position of the helix was barely indicated by a slight reduplication of the superior portion of the auricle, and the anti-helix represented by a slight elevation above the superior border of the concha; the whole of this portion of the auricle resembled that of the chimpanzee, or of the cases of dementia given by Prof. Laycock. The meatus was represented by a slight depression bounded anteriorly by a well-formed tragus, which latter was supplemented anteriorly by a small cartilaginous nodule, as in the cases described by Gruber. The perception for musical tones on this side of the head seemed to be good, and the integument covering the meatus could easily be depressed by means of a probe. Under these circumstances an exploratory operation was advised, but unfortunately the patient did not return at the time appointed. The family history gave no corresponding cases of malformation, and the patient herself was perfectly healthy and otherwise well developed.

The case of *spurious othæmatoma* occurred in a woman thirty years of age who received a severe blow upon the left ear from a fall, fracturing the cartilage and causing extravasation on both anterior and posterior surfaces of the auricle. Anteriorly the swelling extended from the fossa of the helix to the lower border of the concha, and posteriorly from the curve of the helix to about the centre of the concha.

Shortly after the accident, and following exposure, the auricle became red and painful; an opening one inch in length was made into the lower portion of the posterior swelling, resulting in the discharge of about one ounce of laudable pus, and the complete emptying of both sacs. The cavity was syringed with a weak solution of carbolic acid, and a cloth tent introduced; this was continued for about a week, after which, the walls of the sac being kept in apposition by means of compress and bandage, and the opening allowed to heal, the patient recovered rapidly with comparatively little deformity, the depression of the concha being only partially obliterated, and the elevation of the anti-helix being plainly discernible.

The *fibrous tumor* of the lobe occurred in a negro woman twenty-three years of age ; that removed from the right lobe by means of the usual triangular cuts with the scissors was about an inch in diameter, and included the perforation which had been made for an ear-ring. The cuts were made to follow the outline of the tumor as closely as possible, and the edges brought together by means of straps, uniting by first intention for about a third of their extent, and healing finally with but little deformity. A fibrous tumor of nearly the same size was subsequently removed from the left ear of the same patient by Dr. Shaw.

Of the cases of *accumulation of cerumen* in the meatus in males, 39 occurred in the right ear, 53 in the left ear, and 59 in both ears ; in females, 24 in the right ear, 33 in the left ear, and 27 in both ears. The average age of the cases collectively was 35 years. In the females, as a rule, the trouble had been of short duration, and the accumulated mass was soft and easily removed ; in the males, on the other hand, the cerumen plugs were generally more firmly impacted, and the cerumen mingled throughout with fine dust or other foreign matter, which was sufficient, on closer examination, to indicate the occupation of the patient. Such cases occurred principally in coal-heavers and stokers, machinists, wood-turners, street-laborers, and stone-workers. The more obstinate cases were found usually in old men of the laboring class in whom there was a tendency to eczema of the auricle and meatus ; in such cases it was the practice to soak the cerumen plug thoroughly with warm water, and then to pass a flattened probe between the ceruminous mass and the floor of the meatus to the depth of half an inch, thus making an opening for the entrance of the water in syringing.

Other instruments than the syringe were rarely employed in the extraction of these plugs, and as a preliminary treatment tepid water, as a rule, was found to be a better solvent than any of the solutions recommended by various writers. In clinical practice, where it is necessary to treat a large number of cases in a few hours, much time may be saved by filling the meatus with warm water, and introducing a large-sized Politzer's manometer, which may be refilled from time to time until the softening process is complete.

Among the more remarkable cases was one in a man 76 years of age ; two firm plugs of cerumen filling the inner end of the meatus being found to be covered with a dense growth of *aspergillus flavescens*, the removal of the masses permanently relieved the symptoms characteristic of the presence of this fungus. The foreign bodies, consisting of beans, pins, insects, a piece of slate pencil, a round glass button and a small cockle-shell, were removed by syringing, with the exception of the three latter, in which it was necessary to resort to the forceps, the method of Löwenberg, and the blunt hook before the extraction could be effected.

Of the cases of *eczema of the auricle* and meatus, about 60 per cent. occurred in children under ten years of age, and of this number two-thirds were females, the disease affecting, as a rule, children of the very poor, poorly nourished, and unclean. The treatment in these cases consisted usually in the application of olive oil, which was allowed to remain over night, and washed off with weak warm soap-water in the morning ; one or two applications were generally sufficient to soften the large crusts, and the subsequent treatment consisted principally in the use of the benzoated oxide of zinc ointment, as being more easy of application than any form

of wash, and in the more severe cases, in addition, a daily dressing of the parts affected with charpie dipped in a mixture of glycerine and water, to which the sulpho-carbolate of zinc was sometimes added. In the adult cases the affection could usually be traced to exciting causes, among which the pernicious practice of cleansing the ear with a pin or ear-spoon played a prominent part.

The majority of the cases demanded general as well as local treatment, such as the use of tonics, preference being given to preparations of iron and quinine, and a more generous diet.

One of the cases of *wound of the meatus* occurred in a girl 11 years of age, who was recovering from a slight inflammation of the right membrana tympani. The point of a hard-rubber syringe had been thrust forcibly into the ear, tearing the integument of the meatus to the depth of half an inch, and rupturing the membrana tympani. The accident was followed by severe, deep-seated lancinating pain, accompanied by vomiting and occasional vertigo; the patient was brought to the clinic immediately after the occurrence of this accident, and an attempt to syringe the ear resulted in a severe attack of vomiting and considerable dizziness and dimness of vision. A leech was applied in front of the tragus, and instillations of warm water and the application of an ointment of the extract of hyoscyamus and morphia over the mastoid recommended. On the day following the pain was much relieved and the nausea and vertigo had not recurred; the tepid instillations were continued until the blood coagula had been entirely removed, when the wounds both of the meatus and membrana tympani healed readily with but slight impairment of hearing.

The second case was that of a laboring man, 36 years of age, who received a severe blow upon the region of the left mastoid, resulting in a slight wound of the meatus and an extensive rupture of the membrana tympani; there was considerable hemorrhage, which was followed one hour later by severe deep-seated pain, accompanied by nausea and

vomiting. On the second day a thin discharge appeared; this soon became purulent and offensive, and with the change in the character of the otorrhœa there occurred occasional attacks of vertigo, accompanied by deep-seated throbbing pain. At the time of admission the meatus was found to be somewhat congested, and the membrana tympani perforated, and giving passage to a copious purulent secretion. Syringing with the tepid water, the instillation of a warm solution of sulpho-carbolate of zinc, six grains to the ounce, and the internal administration of the hydrate of chloral relieved the pain and accompanying symptoms, and diminished the quantity and fetor of the discharge; the final result being a closure of the perforation and partial restoration of hearing.

The cases of *otitis externa circumscripta* were equally divided between males and females, the left being the affected ear in about 50 per cent of both. In both sexes the inflammation of the meatus accompanied some disturbance of the digestive organs, and was generally attended by constipation; in all but two or three cases there was a tendency to further development of furunculi, which was combated by general treatment, including a gentle laxative, tonics, and a more generous diet. The local treatment consisted, as a rule, in free incision and subsequent syringing with warm water. The full development of furunculi was sometimes prevented by the application of a saturated solution of nitrate of silver.

Of *otitis externa diffusa* over 57 per cent. were in females; the majority of the cases in both sexes occurring during the autumn and winter months, and affecting one side only.

As in the preceding affection something more than local treatment was required in most of the cases, the

patients being usually of the poorer class and ill nourished; in such as did not belong especially to this class, the trouble could be traced to some special cause, as direct injury to the part, or excessive exposure. Most of the patients had been suffering from severe pain for one or two days before applying for relief, and the disease was consequently at that stage which is characterized by extreme congestion and great tenderness, and to which the treatment recommended and employed by Gruber is especially applicable, namely, free incision of the congested parts, from one to three cuts, varying from a quarter to three quarters of an inch in length, being made from within outwards parallel to the long axis of the meatus, bleeding being encouraged by subsequent syringing with warm water. Aside from the almost immediate relief afforded by this method of treatment, it possesses the further advantage of arresting the progress of the inflammation, and preventing structural changes which might have a subsequent effect upon the hearing. One of its drawbacks is the possibility of the recurrence of granulations springing from the edges of the cuts. This complication, however, generally accompanies only cases in which the incision has been delayed until the parts have become œdematous.

The cases recorded under the heading *myringitis*, were those in which the membrana tympani was especially the seat of inflammation, and the affection being one which seldom occurs uncomplicated, a more careful record was kept with the view of ascertaining so far as possible the cause. Of the thirty-six cases recorded, 8

occurred in the month of August, all of them in males, of whom 7 were under thirty years of age ; and in 5 of these the inflammation was directly traceable to sea-bathing as the immediate cause. In July there were 6 cases of myringitis, all of them in males, and in 2 cases traceable to sea-bathing. In March, April, and May preceding, there were no cases recorded.

In February, 4 cases, 3 being females. In January, 8 cases, 5 males and 3 females ; of these latter, all of the males, with one exception, were under thirty years of age, and engaged in occupations which implied exposure to cold and wet, and to sudden changes of temperature.

In December, 2 cases, both females, the disease being directly traceable to exposure to inclement weather. A further review shows that those cases of myringitis occurring during summer months were principally in young males, and traceable to a cause pertaining at that season, while of the cases occurring during the winter months, more than half were females under thirty years of age ; and of the males 50 per cent. were children under ten years of age, and the remainder young men whose occupations rendered them liable to exposure.

A comparison with private records confirms the conclusions which would be drawn from the above table with regard to the ætiology of myringitis ; the majority of cases, during the summer months, occurring in young males during the season of sea-bathing, and more or less directly attributable to the effect of cold salt-water entering the ear ; during the winter months myringitis occurred more frequently in young females with the

advent of snowy weather, and with the cold wet weather of spring-time, there being fewer cases, as a rule, in the interim during settled cold weather, and these cases occurring principally in males as the result of especial exposure. The majority of the cases applying at the Infirmary were in the acute stage of the disease, the membrana tympani being much congested and swollen, the point of insertion of the malleus being represented by a depression, and the inflammation being accompanied by considerable congestion of the meatus; the hearing had generally decreased to a minimum, being on an average from $\frac{1}{7\frac{1}{2}}$ to $\frac{5}{7\frac{1}{2}}$ for the watch. The immediate treatment in most of these cases consisted in *free scarification of the membrana tympani*, from two to four cuts being made in each case, the points selected for incision being those of greatest prominence or greatest degree of congestion, care being taken not to cut through into the tympanum. The amount of hemorrhage was in no case sufficient to fill the inner end of the meatus, but the pain and sensation of fulness were almost immediately diminished and the hearing increased.

Subsequent treatment consisted in the use of the air-douche or catheter, preferably the former, and such general treatment and attention to the condition of the pharynx as the case required. As a rule, it was not necessary to repeat the scarification.

Of the cases of *otitis media purulenta* 51 per cent. were males of an average age of 21 years; the average age of females suffering from the same disease being 15 years; of males 20 per cent. and of females 36 per cent.

were under 10 years of age. In about 25 per cent. of these cases, in both sexes, the purulent inflammation was accompanied by the presence of granulations springing from the middle ear, or from the outer surface of the membrana tympani.

In the majority of these latter cases, the otorrhœa had persisted for a considerable time, but in a few patients in whom perforation of the membrana tympani and purulent discharge were found accompanied by well-marked granulations, the commencement of the disease dated back from two to three weeks only. Such cases occurred principally during the winter months in young males, and the granulations were generally noticeable for their exuberance, and for the readiness with which they disappeared under the application of nitrate of silver.

Among the more obstinate cases were two, in which there existed in addition to perforation of the lower portion of the membrana tympani an opening above the short process of the malleus. In both of these cases the larger portion of the purulent discharge found its exit from the middle ear through the inferior opening, while the cavity above was filled with soft granulations, which could be reached only through the superior opening. In addition to the usual treatment, strong solutions of the sulpho-carbolate of zinc were injected through the latter perforation by means of a middle ear-syringe, and pledgets of cotton-wool soaked in a saturated solution of nitrate of silver were introduced every alternate day. Under this treatment the granulations finally disappeared, the discharge diminished, and a very vexatious complication was overcome.

The treatment in uncomplicated cases of purulent otorrhœa consisted in frequent and thorough syringing with tepid water and the instillation of solutions of the sulpho-carbolate of zinc, of from four to ten grains to the ounce; this double salt seems to have a more beneficial effect in such cases than solutions of the sulphate of zinc of the same strength, and possesses the still further advantage of more appreciably diminishing the fetor of the discharge.

In long-continued cases the saturated solution of nitrate of silver was applied with good results, especially in children, and in several cases where the discharge was distinctly muco-purulent Yearsley's treatment of packing the middle ear with dry cotton wool had a beneficial effect. In such cases it was the practice to cleanse the ear thoroughly by means of the air douche and syringing, and after drying to pass small pledgets of fine jewellers' wool through the perforation in the membrana tympani, packing them in by means of a probe. These could be easily removed on the following day and the packing repeated. The discharge gradually diminished in quantity and became more tenacious, so that towards the latter part of the treatment it became necessary to moisten the pledgets slightly before extracting.

Of the more serious cases of purulent inflammation of the middle ear there were none in which it became necessary to open into the mastoid cells, although redness, swelling and tenderness over the mastoid region were not rare accompaniments during the winter months. These patients were taken into the Hospital, if possible,

and leeches freely applied behind the ear, in each case with relief and a subsidence of the alarming symptoms.

Of the cases of *otitis media catarrhalis chronica* 52 p. c. were males, with an average age of thirty-five years ; and 48 p. c. females, with an average age of thirty-four years ; and in about 95 p. c. of the cases in both sexes tinnitus aurium was or had been a prominent symptom of the existence of disease. In addition to the usual application to the pharynx and naso-pharyngeal space ordinarily required in these cases, and the use of the air douche and catheter, with the injection of medicated solutions and vapors, repeated myringotomy was resorted to by the writer in several cases.

The cases chosen for this treatment were those in which the disease had persisted for a long time, the hearing being very considerably diminished and the Eustachian tube with difficulty permeable, the perception for sound conveyed through the bones of the head, however, being good, and the membrana tympani concave, thickened, and opaque, but without congestion, calcareous deposits or further structural change. The operation was performed with the adjustable myringotome, and repeated every third or fourth day, different portions of the membrane being chosen for each incision ; during the experiment all other treatment, with exception of the use of the air douche, was suspended. In all cases the openings healed readily within forty-eight hours, and without perceptible improvement, until after the third or fourth incision had been made, when the Eustachian tube was found to have become much more readily permeable, the hearing to have increased in

varying degree, and in some cases the tinnitus aurium to have sensibly diminished. The theoretical grounds on which this treatment was instituted, and the reasons for improvement, probably are the diminished resistance to passage of air into the middle ear through the Eustachian tube, the membrana tympani being perforated; and, secondly, the irritation consequent upon the repeated incisions resulting in a diminution of the thickening of the membrana tympani. In none of the above cases was there any liberation of secretion in the middle ear by means of the incisions which would account for the improvement in hearing; these cases, moreover, improved still further under subsequent treatment by means of the catheter.

In the cases of *serous accumulation* within the middle ear, of which six were males and two females, myringotomy was also resorted to as the readiest means of arriving at an early termination of the disease, in all cases with beneficial results, and, so far as could be determined, without subsequent detriment to the hearing. In one case in which the peculiar form of sac described by Politzer* persisted after the liberation of the secretion, repeated incisions were made which resulted in a contraction of the sac and considerable improvement in hearing.

The two cases of *otitis intermittens* occurred in males who were subject to malarial fever. The affection was characterized by pain of a neuralgic character, conges-

* Beleuchtungsbilder des Trommelfells. The Membrana Tympani in Health and Disease. Translated by Drs. A. Mathewson and H. G. Newton. W. Wood & Co., New York. 1869.

tion of the membrana tympani, and accumulation of secretion within the middle ear; the attack was in each case coincident with general malarial symptoms, and followed the course of the febrile attacks in its increase and abatement. In both cases local treatment of the aural trouble gave no relief until supplemented by the administration of quinine, when the aural symptoms disappeared with the subsidence of the primary affection.

Of the cases of *deaf-mutism* 61 per cent. were males; in four of these cases the loss of hearing dated from an otitis media purulenta following scarlet fever, and in three cases, in which the membrana tympani was of normal appearance, the deafness was traceable to a disease, the symptoms of which agreed with those given by Voltolini* as characteristic of otitis labyrinthica.

In connection with the cases of perforation of the membrana tympani a series of *experiments* was instituted *with regard to perception of high musical tones*, a summary of which has already been published.† Cases in which it was necessary to perforate the membrana tympani were also availed of for the same purpose, the object being to account, if possible, for the discrepancy in the statements of various authors with regard to the limit of perception of high musical tones, and also the limit of such perceptions, and the conditions of the sound-conducting portion of the ear favorable thereto.

For this purpose a series of König's rods of white tempered steel, ranging from 35,000 v. s. to 85,000 v. s.

* Monatsschrift für Ohrenheilkunde.

† Transactions of the American Otological Society, 1872.

was employed, the rods being suspended at a uniform distance from the ear by means of loops of fine wire and set in vibration by a stroke from a steel hammer. The results obtained were such as not only to stimulate to still further investigation, but to establish the value of the instrument for diagnostic purposes. In the majority of the cases of chronic catarrhal inflammation of the middle ear the limit of perception terminated at 35,000 v. s.; in the exceptional cases it reached 40,000 v. s., and even 50,000 v. s., but in these cases the membrana tympani was found to be very concave, uniformly thickened, and varying its position but slightly under the action of either the air douche or catheter. This correspondence between the perception of a higher tone and a concave membrana tympani would be accounted for by the increased tension of a membrane of uniform thickness, responding more readily to shorter sound waves. The same point was illustrated in a case of *voluntary contraction* of the musculus tensor tympani.

† The patient was a woman thirty years of age, who applied at the Infirmary for relief from a slight pharyngeal catarrh. The membrana tympani was transparent and of normal appearance, with exception of a slight central depression, the result of temporary closure of the Eustachian tube.

Upon voluntary contraction of the muscle the long process of the malleus was seen to move inwards, together with the central portion of the membrana tympani, the hearing for the voice and for all deeper tones diminished, and that for higher tones increased from 35,000 v. s. to 40,000 v. s.

The same observation was confirmed in another case occurring in private practice, in which the perception for high tones increased from 40,000 v. s. to 50,000 v. s.

during contraction of the musculus tensor tympani, the hearing for deeper tones proportionately decreasing. In this case the hearing was fully normal when the muscle was not voluntarily contracted. In cases of perforation of the membrana tympani in which the opening had become closed by the formation of a cicatrix, the perception for high tones was increased, provided, however, that the cicatrix was firm and tense; if at all relaxed the perception for higher tones seemed to be diminished; the only exceptions to this rule occurred in cases where the cicatrix was in contact with the descending process of the incus; in one case, in which a band of cicatricial tissue extended from the posterior edge of the perforation to the lower end of the long process of the incus a tone of 55,000 v. s. was distinctly heard. In two of the three cases of otitis media catarrhalis in which the test with the König's rods was supplemented by the application of the galvanic current the perception for high tones was increased 5,000 v. s. during the passage of the current, the cathode being applied in front of the ear and the anode held in the hand of the opposite side. The same increase of perception under the use of the cathode with from four to eight cells of a Stöhrer battery was found in corresponding cases in private practice.

Of the cases at the Infirmary during the past year in which *electricity* was employed either *as a means of diagnosis or of treatment*, two may be cited as showing especially beneficial results.

The first patient, a female, sixteen years of age, applied at the Infirmary, in July, for relief from deafness of the left ear, which had been

first noticed six years previously, and had gradually and steadily increased without tinnitus aurium or other subjective symptoms.

The watch (72 inches normal hearing distance) was not heard when pressed upon the auricle, or in contact with the head; the tuning-fork was heard only slightly. The meatus was normal, the membrana tympana somewhat concave, and very slightly opaque, and the Eustachian tube free. The general health was good, with exception of a slight tendency to constipation; the menses, which had appeared two years previously, were regular. The current from six cells of a Stöhrer battery was applied at intervals of three days, the cathode in each case being applied in front of the tragus; there was no dizziness and no subjective symptom, with exception of a slight ringing on the opening of the cathode. Following the first application of electricity, the hearing increased to contact for the watch, and continued to increase steadily with each application until the eighth sitting, having reached a distance of eighteen inches, when the patient unfortunately passed from observation.

In the second case, that of a woman thirty years of age, both ears were affected, the hearing having steadily diminished during a period of four years. Within three months there had been occasional tinnitus aurium. On both sides the meatus was normal, and the membrana tympani very slightly opaque, and somewhat concave. On the right side there was no perception whatever for the watch, while on the left the perception was good, and the watch was heard at a distance of four inches from the auricle. The general health was good, and there was nothing in the history or the appearances to account for the deafness, with exception of a slight catarrhal trouble of the middle ear; there was, moreover, no improvement in hearing following the use of the air douche.

No formula of reaction could be obtained on account of the vertigo accompanying the use of more than eight cells of the Stöhrer battery; but under the use of the cathode, with six cells, the hearing improved in the right ear to contact with the watch, and in the left ear to six inches for the watch.

The same current was applied at intervals of five days from August 5th to August 20th, at which date the hearing in the right ear re-

mained the same, but in the left ear had increased to twenty-eight inches. The patient was next seen on November 6th. The hearing had not diminished, and was still further increased to thirty-six inches.

It was necessary to refer many interesting cases of deafness associated with cerebral disease, and with injury to the cranium, to other institutions, on account of the necessity of retaining all available beds either for operative cases in the ophthalmic department, or for cases of accident requiring hospital treatment.

MINOR OTOLOGICAL COMMUNICATIONS.

By DR. S. MOOS.*

Translated by J. A. Steurer, M.D., of New York.

I. UNSUCCESSFUL ATTEMPT TO EXTRACT A COFFEE-BEAN LODGED IN THE EXTERNAL AUDITORY MEATUS— CONSECUTIVE PURULENT INFLAMMATION WITH PER- FORATION OF THE DRUM MEMBRANE, EXFOLIATION OF THE INCUS, AND DEVELOPMENT OF NUMEROUS POLYPI—PASSAGE OF THE BEAN THROUGH THE PERFORATION INTO THE TYMPANUM AND OUT AGAIN— CICATRIZATION OF THE PERFORATION WITH PARTIAL RESTORATION OF HEARING.

J. I., æt. $3\frac{1}{2}$ years, of Baden-Baden, was brought to me by her parents Dec. 9th, 1867. The little patient had put a coffee-bean in her right ear on Dec. 3d. According to the parents' statement the bean was not far in, and it could be seen. A physician made that evening and the following morning several unsuccessful attempts to extract it by means of instruments, having narcotized her by chloroform. After which the bean could be seen no longer.

In consequence of the pain attending the attempted extraction, and the effects of the chloroform, the child became excited and unwell, and there was a continual purulent discharge from the ear; on that account the physician deemed it inadvisable to do anything further, and gave the opinion that the foreign body might remain in the ear without any bad result.

* This paper appeared in No. 2, vol. ii., of the German edition of the Archives, issued July, 1872.—EDITOR.

The examination on the 9th of Dec. gave the following status : Great pain when pressure was made on the right tragus, and on traction of the auricle, erysipelatous redness of the tragus and concha, occlusion of the meatus by tumefaction of its walls, and slight purulent discharge. Under these circumstances I recommended antiphlogistic treatment, and declined any operative procedure. Requesting further news, I received, on Jan. 9th, the following account : "The condition of the ear has remained apparently the same, the purulent discharge is mingled with blood, but the child is lively, and free from pain. During the last few days I observed a reddish mass filling the meatus, which could not be removed by syringing. The physician who was called declared it to be a polypus which had formed in consequence of the inflammation."

Upon being asked to write my opinion, I declared the polypoid formation to be not merely a result of the inflammation, but also an indication that the foreign body was still in the ear. I was invited to go to Baden, and if any operation should be deemed necessary to perform it there. I fulfilled this request on Jan. 14th.

The examination showed a multiple polypoid formation which had advanced into the external meatus. I declared the removal of the same to be necessary—without any consideration to the foreign body—to prevent any possible retention of pus, and therefore I gave chloroform and performed the operation. It lasted two hours. A great number of granulations which originated from all parts of the meatus down to the membrana tympani had to be removed. The incus, partially exfoliated in consequence of the purulent inflammation of the drum membrane and tympanum but otherwise normal, lay embedded in the granulations. No foreign body could be discovered, even after removal of the granulations, which permitted a careful examination of the membrane and of the tympanum through the perforation. The posterior half of the membrane was destroyed, its anterior half and the mucous membrane of the tympanum as seen through the perforation were reddened and swollen ; but no foreign body could be seen or felt, even after repeated probing of the tympanum. However remarkable it may appear, I had no doubt but that the foreign body had wandered into the tympanum and there remained concealed

from view. I therefore desisted from all further attempts, ordered the patient to lie on the affected side, and have the ear syringed with a concentrated solution of alum twice a-day.

According to the written report of Dr. Seelos the progress of the case was as follows :

Jan. 22d. The child has remained free from fever and pain. Her general health is very good, the purulent discharge moderate, but slightly tinged with blood. The inflammation in the external meatus has diminished, but near the membrane there are ulcers and granulations. The perforation of the membrane still exists, and the mucous membrane beyond it is still granular.

Jan. 31st. Yesterday the bean came into view by syringing. About eight days ago the child was feverish and complained of headache, but these symptoms disappeared before the bean became visible. The child is now feeling quite well. I continue the syringing and alum solution.

The further communications may be condensed into the following : The inflammation diminished gradually, the discharge ceased ; and I found the following condition when her parents brought her to me at the end of March. She heard a watch of 6 feet hearing distance at 5 inches ; understood speech at 18 paces ; external meatus dry. No perforation in the membrane. A large cicatrix in the membrane, whose anterior boundary is formed by the handle of the malleus. On Oct. 7th, 1871, I had another opportunity to examine the ear of the little girl at Baden. The same watch could only be heard at a distance of 3 inches ; but on the other hand the patient could repeat whispered sentences at the distance of 12 paces with great facility. The drum membrane had a very different appearance, only the periphery seemed normal. The whole central portion appeared like an atrophic spot or a large cicatrix. Notwithstanding the great transparency of the membrane, neither the malleus nor the chorda tympani could be seen, but directly upwards I could see the short process, and in the superior anterior quadrant the head of the stapes. The central portion was drawn towards the promontory. Since March 18th, 1871, the child had never complained of her ear.

From the above case we learn the following :—

I. That a foreign body, which cannot swell, lodged in the meatus, and being confined there by the tumefaction, may pass into and out of the tympanum through a perforation in the membrane. In such a case the perforation may occur in consequence of the inflammation or may have existed previously.

II. A partial atrophy of the drum-head may gradually become complete. The gradual progression of the atrophy is favored by the retraction of the handle of the malleus by the tensor tympani, the membrane offering less resistance to the atmospheric pressure. The latter very likely occurred in our case afterwards, that is after the inflammation had diminished, between the end of March, 1868, and the beginning of October, 1871, which was the interval between the two last examinations, for on the last examination but one I could still distinguish the handle in the membrane. In consequence of the suppurative inflammation the manubrium was probably loosened from its connection with the membrane or the scar whose anterior boundary it formed, and was more easily drawn backwards and upwards by the tendon of the tensor tympani as the atrophy of the membrane progressed.

III. The conduction of the sound waves in our case took place in the following peculiar manner: the waves were transmitted from the external meatus to a thin membrane of connective tissue, from this membrane—the handle being absent, and the incus having been exfoliated by the former inflammation—to the air in the tympanum, and thence to the stapes. This condition was very unfavorable to the perception of faint sounds,

for instance the tick of a small watch; but its influence was less apparent in the hearing of ordinary voice, and even whispers.

Taking everything into consideration, we can suppose that the hearing power will not be further diminished, because the pathologico-anatomical changes, as far as they can be determined by ocular inspection, have probably reached their maximum.

II. ALARMING HÆMORRHAGE FROM THE EAR AFTER EXTRACTION OF A SMALL POLYPUS FROM THE SHORT PROCESS OF THE MALLEUS, NECESSITATING A TAMPOON.

Miss H., æt. 18, was brought to me by her father April 16th, 1867. Since an attack of scarlatina in her 6th year there had been a purulent discharge, sometimes mixed with blood, from both ears. The examination discovered on the right side at the inner end of the external auditory passage, on the upper wall, a heart-shaped exostosis similar to the one which I have more minutely described in Vol. II., No. 1, p. 136, etc., of these Archives, further, destruction of the drum-head excepting at the periphery, and the handle drawn against the promontory. On the short process was a granulation as large as a pea; the mucous membrane of the promontory was grayish-red, thickened, and covered with pus. On the left side there was no exostosis, but the inner end of the canal was occupied by a polypus as large as a hazelnut, which rendered the examination of the membrane unsatisfactory; but after its extraction there appeared a large perforation of the membrane with destruction of nearly all the anterior half. The posterior half was depressed with the handle, dull, but otherwise normal. May 14th, the patient came for operation, and on the next day at 10 o'clock in the forenoon the right side was attacked. The exostosis above described rendered the operation rather more difficult than usual, but the extraction of the granulation was accomplished by means of a "Wilde's snare," and its site was thoroughly cauterized by means of a nitrate of silver crayon. Seven hours later, during which the patient had re-

maintained quiet in the house, the right ear began to bleed. As soon as the patient observed this she walked to my house, a distance of about four blocks, to have her ear examined.

Not finding me at home, she obtained a dish to catch the blood. I was sent for, and reached the house in about three-quarters of an hour. By this time the patient was quite anæmic, for she had lost probably from 20 to 24 ounces of blood. The right auditory canal was filled with a coagulum. After removal of the clot, blood spirted out from the depth in a bright red stream, and the flow was not controlled by compression of the right carotid artery.

I at once made a tampon by pressing a wad into the furthest extremity of the auditory canal, sprinkling upon it a layer of powdered alum; then another wad, likewise covered by powdered alum, and so on, until the auditory canal was crowded full. Then a firm ball of charpie was placed upon the auricle, and a bandage applied snugly over all. The patient was sent home to bed, and the strictest rest enjoined her. There was no more bleeding.

After two days the tampon was removed, and the auditory canal was carefully cleaned out. When the tumor had been removed there was a thin, dark coagulum, as large as a lentil. The ear was not disturbed for several days; there was no return of the discharge; and notwithstanding the loss of the membrana tympani, entire absence of the incus, and in-drawing of the handle to the promontory, the patient was able to understand ordinary conversation without the use of an artificial drumhead; hearing distance for my voice was seventeen paces, and three feet for a watch of thirty feet hearing distance.

Unhappily, I neglected to examine the small tumor, but I have no doubt that it was a case similar to the one described by Dr. Buck in vol. ii., part 1, page 72, etc., of these Archives. In that case the tumor was attached to the handle of the malleus by a long pedicle, and the examination showed it to be a polypoid angioma cavernosum.

The hemorrhage was not so considerable as in my

case, where probably it came from the vascular matrix of the tumor, exposed by the separation of the slough seven hours after the cauterization. I must confess that in the first moment, when I saw the profuse bleeding, and after the removal of the coagulum, the blood spurting up from the depths of the auditory canal, I feared that I might have cauterized the carotid artery; and this was partly justified by the considerable destruction of the organ and the long duration of the disease; but, on the other hand, the negative result of compression of the carotid and the positive result of the tampon in the external auditory canal disproved this supposition.

III. EXUBERANT DEVELOPMENT OF ASPERGILLUS IN THE EXTERNAL AUDITORY CANAL, WITHOUT SYMPTOMS OF ANY IRRITATION.

According to the observations of Schwartze,* Wreden,† and others, fungous growths in the external auditory canal are frequent causes of obstinate and recurrent chronic inflammations. Schwartze considers this mould as purely accidental; but Wreden ascribes to it an importance in the phenomena of inflammations of the auditory canal and drumhead similar to that of *oidium albicans* in sprue or *microsporon furfur* in pityriasis versicolor.

According to Wreden, fungous growths are ordinarily not accompanied by suppuration of the auditory canal

* Archiv. f. Ohrenheilkunde Bd. II. S. 5.

† Myringomycosis Aspergillina and its Influence upon the Organs of Hearing, by Dr. Wreden, St. Petersburg, 1868.

or drumhead; and he considers the discharge from the ear, if there be any, rather as a serous exudation caused by the irritative influence of the mould upon the living tissues. In the following case there was no suppuration either, and it was further remarkable on account of the absence of all objective changes and subjective complaints, with the exception of hardness of hearing, as well as the speedy and happy termination

Mr. St., fifty-four years of age, consulted me Feb. 11th, 1871, on account of hardness of hearing on the right side—indeed his hearing was so diminished that he could hear conversation only in a few paces, and a watch of thirty feet normal distance, only at four inches. Conduction of bones present. Now and then, especially when heated, he had noises in the ear, otherwise no complaint, no itching, pricking, or ear-ache. Ocular inspection discovered a plug which was removed by syringing. The black discoloration of the plug extending quite to its periphery suggested a microscopic examination which revealed that the outer layers consisted of epidermis cells thickly covered with *aspergillus glaucus*.

The deafness and noise ceased after the removal of the plug. The handle was found hyperhæmic two days later, but the rest of the drum-head and the meatus were normal. During the succeeding four days the meatus was treated with a 10 gr. solution of *argentum nitricum*. There was no return of the disease; four weeks later there was no appreciable anomaly. In November, 1871, I had an opportunity to examine the patient again; I found the ear normal in every respect, and nothing unusual had been noticed by the patient.

IV.—GUNSHOT WOUND OF THE EUSTACHIAN TUBE.

The following case in reference to the impermeability of the tube, is analagous to that of Dr. Wolff*; for this

* These Archives: vol. ii., No. 2, p. 58, etc.

reason and especially for its rarity, I will report it briefly.

David Kilian, æt. 28, of the 67th reg. Prussian infantry, was wounded at St. Marie, Jan. 13th, 1871. The ball entered below the lobe of the left ear, immediately behind the angle of the lower jaw, and passed out through the right upper jaw. Consciousness was not lost. Much blood and pus soon came from the mouth; during the first three weeks swallowing and speaking were almost impossible. There was marked fever, and for two days and nights ice was kept to the head. On the 11th of February the patient came to Heidelberg, and on the 23d of March he was sent to me by Dr. Mittermaier.

Status on the 23d of March.

He speaks very indistinctly and swallows with difficulty. There is a radiated cicatrix on and immediately below the left lobule which is more closely attached to the neighboring parts and less mobile than the right. There is a second — shaped, partly granular and still suppurating scar in the middle of the right cheek; the right eye is open, somewhat lachrymose, and less easily closed than the left (facial paralysis in consequence of injury to the last branches of the *ansa nervi facialis*). In the left hard palate is a deficiency, large enough to contain a nut, lined with pus. In the external auditory canal there is some dried blood, but no trace of a wound; its inner end and the handle are hyperæmic; the membrana is flat, lustreless, but so translucent that its posterior half permitted me to recognize a yellowish material in the tympanum. When the tuning fork was placed on the left side of the head it was heard; the bone conduction for the watch was feeble, and air conduction only on contact of the watch with the auricle. The voice was heard only in the immediate vicinity of the ear.

Pharyngoscopy, practised in the usual manner, and by means of a very small mirror, placed in the deficiency of the left palate, was unavailable on account of the persistent and considerable suppuration from the palate.

The patient complained of constant hissing in the left ear, occasional slight pain in the left side of the head, and vertigo: but he stated that these symptoms had been present before the injury.

The right ear was healthy.

A paracentesis was then made in the lower posterior quadrant of the left membrana tympani ; but inflation of the drum to clear it from the exudation was impossible, for Politzer's method was impracticable on account of the condition of the palate, and although the catheter could be introduced no air could be got into the middle ear. The exudation was finally removed by the method advised by Politzer in the *Wien. Med. Wochenschr.*, 1870, No. 41, viz. : an airtight auscultation-tube was pressed into the external meatus and repeated suction made with the mouth. A thick yellow material was drawn into the external meatus. Slight otorrhœa set in.

March 24. Another unsuccessful attempt to get air through by the catheter. The more the column of air was forced the greater became the sensation of resistance. Suction was repeated but nothing came out ; the subjective noises, however, were diminished, and the hearing distance increased to $1\frac{1}{2}$ ft. for the watch and 15 paces for the voice.

March 25. Handle hyperæmic, drum-head grayish opaque. The perforation is still perceptible and there is a slight yellowish discharge through it. Hearing the same as yesterday. Catheter again unavailable.

March 26. No discharge. Handle hyperæmic ; anterior half of membrana tympani gives a bright reflex, but the posterior half is dull. Perforation healed. Eustachian tube still impermeable. Hearing distance 3 ft. for the watch and 10 paces for the whispered voice, a little subjective noise. The patient, unfortunately, had to be discharged.

In this case the Eustachian tube was probably occluded by the suppurative inflammation, following the shot wound, and to this occlusion must also be ascribed the presence of the exudation in the tympanum. The improvement of hearing which followed the paracentesis and withdrawal of the exudation I consider only temporary, for, if the tube really was wounded, the unavoidable cicatricial occlusion of the canal will produce a permanent disturbance in the mechanism of the tympanic apparatus.

PATHOLOGICAL OBSERVATIONS ON THE PHYSIOLOGICAL SIGNIFICANCE OF THE HIGHER MUSICAL TONES.

BY DR. S. MOOS.

(Translated by Dr. E. Gruening.)

My attention was called to the subject under consideration by a case of disease which I described in vol. I., part 1., p. 332 of these Archives, under the heading of peculiar disturbances of hearing after cerebro-spinal meningitis. One peculiarity of these disturbances was, that with the left ear the patient was unable to hear the lower tones of the musical scale. He could not perceive the twelve lowest tones of a piano of seven octaves nor the ϵ of the large octave. The patient remained deaf as regards these tones, but gradually regained the power to perceive speech even at a distance of 36'. From this solitary case I could have drawn the conclusion, that for the appreciation of speech these low tones were most probably not essential. On considering, however, the lack of similar cases in literature, I deemed it prudent to postpone my conclusions, and await the opportunity of making further observations.

FIRST CASE.—*Ménière's disease. Sudden deafness of the left ear without an assignable external cause. At first, electrical currents of great intensity produce no reaction of the auditory nerve. Later, slight improvement in the perception of speech. Permanent loss of the musical hearing from a peculiar cause.*

Mr. E., a teacher of music, was sent to me by Prof. Knauff, January 25, 1871.

Mr. E., 54 years of age, gave musical instruction at an institute. He had always enjoyed good health. His arduous occupation of teaching music and singing had no injurious influence upon him. He had never suffered from either nasal or pharyngeal catarrh. According to the statement of Prof. Knauff, the patient had suffered three years previously from eczema capitis, occipital neuralgia, and melancholia. In the beginning of the winter of 1869-70 he regained his previous hilarity, resumed his wonted occupation, and passed the following spring and summer in tolerably good health. He took, as he states, a lively interest in the great political events, "until at the end of the month of November, 1871, this disease of the ear made me so utterly miserable. I gave a singing-lesson from 11 to 12, and in full glee sang the war-songs with the boys. I went to the table with a good appetite, and while at my meal heard a loud report in the head which frightened me very much.' At first I thought the ear had suddenly closed, and I lay down to sleep a little. When I awoke I found myself still in the same condition. With the left ear I heard absolutely nothing, and my head felt rather peculiar. I took a walk, thinking that the fresh air would benefit me. At supper-time I had no appetite; later in the evening I became dizzy and confused, and finally vomited. The next day the family physician administered a powerful cathartic; on the third day leeches were applied behind the ear." After a short time, cold applications became so disagreeable to the patient that he refused to have them made. Subsequently iodide of potassium was given internally, six drachms in all until now. The vomiting ceased on the following day, but the vertigo persisted, confining the patient to his bed for three weeks. Even at present the dizziness recurs whenever he moves his head to and fro. The patient suffers from violent and continuous noises, which he likens to the

dashing of agitated water against the shore. The hearing remained completely abolished. In solitude and during the night the subjective noises cease almost completely. On awaking in the morning the patient hears them but slightly. During the day they increase by every external noise, especially the din of the street. Intense objective noises render the subjective auditory sensations of the patient almost intolerable. "When I hear these external noises my skull seems to become hollow; and when my own noises are aroused by them, I lose all power of thinking." In this condition the patient hears speech imperfectly with his right ear. He states that he hears and understands his own voice with his right ear exclusively. Since the beginning of the disease the patient has been unable to pursue his calling. When he plays the piano he hears the tones indistinctly and confusedly. When the piano on the first floor is played, while he stays on the second, he hears all the tones so clearly that he is encouraged to make a new attempt at playing; but on approaching the instrument he becomes aware that his condition is unaltered.

Prof. Knauff and myself examined the patient on the same day, and found him in the following condition:—

Both external auditory canals are normal. The drumhead of the affected side is retracted and without lustre, the handle of the hammer decidedly hyperæmic, and the mucous membrane opaque. Eustachian tube permeable. On auscultation no râles heard. This examination does not increase the hearing distance, which is almost nil for speech. The patient understands words loudly spoken into the ear. The watch (hearing distance 30') is heard from the left temple, and in contact with the auricle. Tuning forks C', C," and A are heard with the right ear, by conduction through the bones of the head and through the air. With the left ear the patient neither hears the tuning forks nor the tones of a piano at a distance of 24'. In close proximity the tones of the piano appear confused, and produce subjective noises. With the double otoscope we could hear the tuning forks vibrating on the head, on either side, but somewhat less distinctly on the left side. The hearing distance of the right ear is also somewhat diminished, a watch being heard at a distance of 3', instead of 6'.

The drumhead has no light spot ; the mucous membrane is opaque. Curvature and position of membrane normal. No hyperæmia of handle of hammer.

The examination of the left ear with the constant current gives a negative result, no reaction being produced with 30 Siemens-Halske's elements, even when, after a prolonged action of the anode, the current is turned to the cathode.

On February 4, condition unaltered. A systematic galvanic treatment is begun. Thirty elements (anode action) have no effect upon the subjective noises. (These are still likened by the patient to the noise of water dashing against the shore.) Reversion of the current (30 elements) from the anode to the cathode neither intensifies the existing noises nor creates additional auditory sensations. The watch is heard from the left temple and in contact with the auricle. No change as regards the hearing of tuning forks and speech. Iodide of potassium discontinued.

February 6. The patient states that the noise of the streets drives him to desperation. He suffers terribly from noises, especially in the left side of the head. To-day the functional examination before and after treatment gives the same result as on February 4. The electrical treatment produces a different effect. At the anode closure (30 elements) the noise ceases completely. On turning the current to the cathode a singing tone of high pitch is produced, which lasts through the duration of the cathode, disappears at the opening of the cathode and the closure of the anode, and reappears, somewhat diminished in intensity, at the opening of the anode. I advised the patient to play the piano, with his left ear tightly closed, and to notice whether he could perceive the tones more distinctly. This experiment gives no favorable result, the tones being heard as confusedly as before. Ordinarily the patient is free from vertigo ; this, however, appears, whenever he moves his head either forward or backward. (The patient never complains of vertigo during and after the electrical treatment.)

Currents of various intensity (from 30 elements down to 18) give the same result formerly obtained with 30 elements only. Tuning forks and watch heard as before. Speech at 4'.

February 18. The same formula is obtained with a current of 6 elements. (No reaction with a current of 3 elements.)

Ca Cl — Ringing''
 Ca D — Ringing' ∞
 Ca O — o
 An Cl — o
 An D — o
 An O — Ringing'

During the action of the anode the subjective noises invariably cease. After the opening of the anode they reappear sometimes in one hour, sometimes in several hours.

February 19 to 24. Same condition. Hearing distance 16'.

February 25. Dizziness and noises lessened. Speech at 16'. A constant current of 15, 12, 9, and 6 elements gives the formula of so-called hyperæsthesia according to Brenner. The subjective noises abate during the action of the anode, but do not cease completely with less than 30 elements.

The galvanic treatment was continued daily till March 18. The result was as follows: Speech was heard at a distance of 16'. Watch and tuning forks (by conduction through the bones of the head) as before. The subjective noises either diminished or ceased completely during the action of the anode, and were still intensified by external noises.

The subjective noises were neither increased by beats nor by the single tones of the musical scale. These and the following facts were noted by Prof. Helmholtz, who kindly examined the patient. The patient heard the lower tones and the whole octave of c' distinctly, the first four tones of the next octave, from d'' to g'', indistinctly, and the higher tones not at all.

Epicritical Remarks.—The above-described case is a representative of a form of disease not rarely met with. It was first described by Ménière, and recently fully discussed by Knapp in these Archives, vol. ii., part i., p. 204. In the history of this case we find absolutely no cause which may account for the sudden

annihilation of the function of the left ear (apoplectiform deafness of Knapp). The patient was only 53 years of age; his heart was sound; and still it is possible that, owing to an atheromatous condition of the arteries, a hæmorrhage ensued into the left inner ear. Nothing else can have taken place. This hæmorrhage, producing a paralysis in the cochlea and an irritation in the vestibule, occurred with a loud report heard by the patient only.*

Though the patient stated that he had never suffered from any affection of the ears, still it is evident from the opacity of the left drumhead and the impairment of hearing as regards the watch on the right side, that the organ of hearing was not intact previous to this attack. This has often been observed in cases of Ménière's disease. While in most cases the subjective noises are quenched by the objective, and increase in solitude and especially during the night, it was quite the reverse in this patient. His noises either diminished or ceased completely in solitude and during the night, and increased by objective noises, especially the din of the street, and also by music. This condition may be explained in the following manner: In the majority of cases subjective auditory sensations are caused either by an increase of intra-aural pressure, by changes in the labyrinth, or by a combination of both conditions, e. g., in the so-called chronic catarrh of the tympanic cavity.

* The seventh case of Ménière is analogous to our case. See Knapp: A clinical analysis of the inflammatory affections of the inner ear. Arch. Ophth. and Otol. Vol. ii., Part i., p. 230. "A young lady felt suddenly a 'coup de sang' in her left ear, etc."

In our case the hæmorrhage produced primary changes in those parts, by means of which, according to Helmholtz, noises are perceived (membranous sacs ; ampullæ). The anatomical lesion consequent upon the hæmorrhage did not annihilate, as it appears, the function of these parts, but left a condition of irritation which showed itself particularly under the influence of objective noises, while quietude, repose, and seclusion acted soothingly. It is evident that this state of irritation in the vestibule interfered materially with the musical appreciation of the comparatively healthy ear. As often as the patient heard music in close proximity or played himself, noises of great intensity were produced in his left ear, which rendered him incapable of judging competently of musical tones and clangs, and finally caused an intolerable musical confusion. As the mechanical closure of the left ear could not counteract this effect, the irritation must have been intense. The conduction of the musical tones through the closed ear (and the bones of the head?) were still sufficient to confuse the musical perception. In the cochlea the hæmorrhage caused at first a complete and finally a partial loss of function. The nervous fibres were paralyzed: this is proved by the observation that, at first, the most intense galvanic currents failed to produce a subjective auditory sensation ; later, the auditory nerve reacted, and the patient presented the symptoms of a partial loss of the cochlear functions. The nervous fibres serving for the perception of the higher musical tones were principally involved. The perception of speech returned in a limited degree. The permanent loss of musical perception was not caused

by this partial paralysis, but depended upon the condition of irritation in the vestibule.

SECOND CASE.—*Affection of the organ of hearing, presenting the symptoms of so-called Ménière's disease. Deafness of the right ear. Permanent deafness as regards the lower tones. Return of the perceptivity for the high tones. Partial return of the perception of speech.*

Mr. M., aged 54, a government official, consulted me on July 10, 1871. He stated that he had always enjoyed good hearing, and that with his left ear he still heard very well. The latter statement was not borne out by the examination. During the past few years the patient had noticed a gradual diminution of hearing of the right ear, without, however, being annoyed by any particular subjective sensations. For this affection of the right ear he had been treated, without success, by two physicians with the catheter and injections into the middle ear. About fifteen months ago, an intense whizzing noise, accompanied with vertigo and vomiting, appeared in the right ear, without any assignable cause. On account of these additional phenomena a third physician was consulted, who made the stomach responsible for all these symptoms, and prescribed in accordance with this view. As, however, his remedies did not produce the desired effect, the catheter was again resorted to, without better success. Every mental effort, every excitement, increased the noises and caused vertigo, with staggering from the affected side toward the sound side. Bodily exertion, *e. g.*, travelling, had the same effect. Quite recently, while making a small tour on a railway, he had an attack of vertigo, from which he recovered after two hours of rest. The changes of weather, especially the transition to rain, the beginning of winter, imminent thunderstorms, manifested their influence by an increase of the noises and a diminution of the acuity of hearing. The whizzing noises of the ear were at times changed into humming noises heard in the head. Besides the whizzing noises the patient perceived, incessantly, the beats of the pulse in the affected ear. He did not complain of palpitation of the heart.

On examination, I found the right auditory canal spacious, dry; the drumhead opaque, somewhat sunken; handle hyperæmic, middle ear accessible. No râles on auscultation. He understood loudly spoken words at a distance of 1'. The watch (hearing distance 30') was heard at the distance of 2" and from the temple. Tuning forks (C' C'' A) were neither heard by conduction through the air nor through the bones of the head. By the latter conduction the tuning forks were always heard with the left ear, the acuity of hearing of which was 5' for the watch. Perception of speech was good. The electrical examination of the right ear (15 elements, external arrangement) showed hyperæsthesia, with reversion of the formula according to Brenner:

R.E. 15 el. Ca Cl — 0
 Ca D — 0
 Ca O — Seething >
 An Cl — Seething '
 An D — Seething ∞
 An O — 0

The subjective noises diminished in intensity during the action of the cathode, ceased completely with a current of 30 elements, and increased during the action of the anode.* After ten sittings the patient felt his head lighter, but the subjective noises, though silenced by the action of the current, always returned in a milder form. The hearing distance for speech was 12', for the watch 5". By conduction through the bones of the head the tuning forks were always heard on the left (healthy) side. After the tenth sitting, in the afternoon, the patient perceived whizzing noises in the forepart of the head, in the evening. This symptom generally appeared as the forerunner of an imminent attack of vertigo. The attack occurred the next morning. The patient went to bed immediately. In the afternoon he rose and sat down at the table. After having eaten some soup, he felt an inclination to vomit. He again lay down, but still vomited. "I had a sensation as if somebody pierced my brain from below upward." The vertigo

* It is remarkable that the patient, in spite of his tendency to vertigo, never became dizzy during the passage of currents of such intensity.

ceased in bed, and the patient felt comfortable as long as he lay quietly on his back, but as soon as he moved his head from right to left, or from left to right, the vertigo returned. Hearing distance 10'. Whizzing noise not materially increased. Head neither hot nor heavy. Pulse 64, vigorous. Temperature 37.1 C. Heart and aorta normal. Two days later the electrical treatment was resumed. After ten other sittings the result was as follows: Hyperæsthesia with reversion of the formula still existed. The whizzing ceased completely during the action of the cathode with a current of 30 elements. The hearing distance for speech was improved to 30', for the watch to 9". The result of the examination with the tuning forks was very remarkable. The vibrating tuning forks placed upon the bones of the head were still heard on the left side. The patient heard the tuning forks C' and C'' when placed before his right ear. When I held the tuning fork A before his right ear, he said: "I do not hear A: I hear a different tone." The patient evidently heard its overtone e'', the twelfth. The examination with the piano showed the following:—

The patient stood in an adjoining room at a distance of 24' from the piano, with his sound ear closed; the low tones he did not hear at all; from f he heard the single tones, from f to d they appeared equal, from d he heard them more and more distinctly. The patient was discharged on August 2.

The foregoing case is also one of Ménière's disease. In this case the middle ear had been affected some time before the occurrence of the attack, which destroyed almost totally the function of the right ear. The symptoms accompanying and following the attack were those commonly found in cases of Ménière's disease. The interesting feature of the case is the return of a comparatively good perception of speech in spite of the deafness for the lower tones up to f.

In an electro-therapeutical point of view the case is remarkable.

As stated above, the patient showed, on electrical examination, Brenner's formula of so-called hyperæsthesia with reversion of the formula. I had the opportunity of corroborating Brenner's statement in different patients; and though we do not yet know what particular state of the auditory nerve this formula indicates, it is nevertheless therapeutically important to note this reaction, as the treatment of these cases with the anode invariably aggravates the disease.

THIRD CASE.—Complete left-sided deafness after cerebro-spinal meningitis. Considerable diminution of the acuity of hearing of the right ear. Change of the acuity of hearing as regards the high musical tones and simultaneous oscillation of the acuity of hearing as regards the perception of speech. Hyperæsthesia of the right auditory nerve with reversion of the formula according to Brenner.

A. S., æt. 14, suffered with croup when he was six years of age, and was successfully operated upon by tracheotomy. Until March 8, 1871, he had enjoyed good health. On that day he came home from school very much excited, and stated that he had suffered a great wrong. He did not eat his dinner. In the afternoon he played in the street, with other boys, till 4 o'clock. When he entered the house he complained of vertigo and headache. A few hours later a high fever supervened. The next day the temperature rose to 41° C. The patient passed into a comatose condition unaccompanied with delirium; it was difficult to rouse him. Accidentally some boards fell to the floor near his bed; in spite of the great noise, he did not react. The change of bedclothes in the evening did not rouse him. His hands and feet were stiff. An hour later he recovered his consciousness for a few minutes, and then became again profoundly comatose. During the following 14 days and nights he lay with his eyes fixed and his head deeply pressed into the pillow in wild delirium almost continually, only having a lucid interval now and then. Rigidity of the extremities alternated with spasms. At first, vomiting occurred often, later more rarely. Bowels at times constipated.*

* I wish to inform those who do not consider this case as one of cerebro-spinal meningitis (there are undoubtedly such as would prefer to diagnosticate acute idio-

Fourteen days after the beginning of the disease the patient regained his consciousness, but was completely deaf. He could not even hear the ringing of bells close to his ear. In the fourth week he had an exacerbation of all the symptoms; the headache became very violent, and the patient cried out incessantly that there was something growing in his head. Now and then he complained of pain in his ears. The total deafness was persistent. In the fifth week the symptoms abated. In the sixth week the patient made the first attempt to leave his bed. At first he could not stand, and even many weeks later, on attempting to walk, fell on the floor. When he rose from his bed he could understand single words uttered slowly and with a loud voice. In July, the weather having been uninterruptedly warm, his condition improved somewhat. A systematic treatment with iodide of potassium gave no good result.

I examined the patient the first time on August 12, 1871. To the history of the case, as given above by the relatives, I may add, that the patient suffered on both sides from continuous, subjective noises, varying in intensity. On inquiry, the patient stated that his noises increased by external noises. The patient compared the quality of the subjective noises to the distant rolling of a cataract.

The examination of the drumheads and catheterization on both sides showed no anomaly. The left ear heard absolutely nothing; with the right ear the patient heard a watch (hearing distance 30') at $1\frac{1}{2}''$; loud speech at 2'. There was no conduction through the bones for the watch and the tuning forks C', C'' and A. The patient stated that, with his right ear tightly closed, he heard the vibrating tuning forks in the head, and more distinctly yet, with both ears closed. C' he heard best, C'' less distinctly, and A least distinctly. He was not able to localize these tones correctly. Through the double otoscope the tones were conducted with equal distinctness from either side into the ear of the examiner (this examination was frequently repeated). As regards the perception of the single musical tones I found the following: The patient heard G' faintly; B, C, D distinctly; the tones

pathic inflammation of the labyrinth) that four days later the mother of the patient became sick, showed the same symptoms, excepting those concerning the auditory apparatus, and is still suffering from paraplegia.

from D to a less distinctly, and gradually still less distinctly from a to f''; f'' was heard clearly, all the following tones to c''' faintly; c''' and the higher tones were not heard at all.

On examination with the constant current I found to-day and on the following days :—

- RE. 12 el. Ca Cl — Diminution of the subjective noises.
 Ca D — Cessation of the subjective noises.
 Ca O — Seething >
 An Cl — Seething', increase of the subjective noises.
 An D — Seething' ∞ do.
 An O — o Return of the subjective noises.

According to Brenner this is hyperæsthesia with reversion of the formula. The patient was henceforth treated exclusively with the cathode, which invariably caused either a diminution or a cessation of the subjective auditory sensations. After treatment the whizzing noises intermitted from one hour to several hours, but never till the next sitting. On September 15 an improvement of hearing was demonstrable; the watch was heard by conduction through the bones, and speech at 14'. The patient heard only the seven highest tones faintly even in close proximity; the other tones he heard distinctly at a distance of 24'. On September 18 the watch was not heard by conduction through the bones; speech at a distance of 16'; watch at 6''.

September 22. Watch again heard by conduction through the bones; speech at 24'. Condition unaltered. September 25. Watch heard by conduction through the bones; speech at 24'. Tuning fork on vertex heard on the right side, without closure of the right ear. All the tones of the piano heard distinctly excepting the seven highest, but these more distinctly than at the last examination. Latterly, the patient had been treated with the cathode only, and always with the above-mentioned result as regards the noises. The treatment was discontinued till October 11. The hearing distance for speech diminished to 4'. Through the bones of the head C' was perceived faintly in the head, C'' more faintly, and A not at all. The tones of the piano were heard distinctly to g, from g up only faintly. Watch at 2''; through the bones of the head not at all. The whizzing noise

increased; the electrical formula remained the same. The treatment with the cathode was again resumed, and continued daily till October 21. On this day the examination showed the following:—Hearing distance for speech 24'; watch at 6'', and by conduction through the bones. All the tones of the piano distinctly heard, and at the same distance as before. The three tuning forks, placed on the head, were more distinctly heard than before; after closure of the ears their sounds were very loud, but the patient was still unable to refer the perceived tones to either the right or the left ear. The whizzing noise diminished.* November 25. The treatment has been suspended since four weeks. The condition of the patient was as follows: Whizzing noise increased; from d'' all the tones were faintly perceived; the tuning forks, including C'', were also very faintly heard through the bones of the head. Hearing distance for speech 2', for the watch $1\frac{1}{2}''$; no conduction through the bones.

This case is, undoubtedly, one of Cerebro-spinal Meningitis, with implication of the auditory nerves in the inflammatory process; on the left side this inflammation caused, most probably, a destruction of the nerve—by fatty degeneration, atrophy, etc.—and thus a cessation of function. An exudative process must likewise have existed on the right side. In no other way can we account for the considerable changes in the perceptivity of musical tones.

I explain the process in the following way: When the case came under my observation, the exudative inflammation in the cranial cavity had completely ceased on the right side, while it still lingered in the labyrinth. Here the process was secondary, having extended from the cranial cavity through the porus acusticus internus

* I make the examination with the piano, in the following manner: The patient is placed in a room; the piano is sounded in an adjoining room, at a distance of about 24'; the door connecting the two rooms remains half open.

as a serous inflammation, in the course of which variable quantities of exudation were at times poured out, causing an increase of intra-aural pressure of greater or less intensity.

From the researches on the mechanism of the ossicles by Dr. Burnett, we know that an increase of pressure in the labyrinth destroys, first, the perceptivity of the higher tones, and later, that of the lower tones. The history of this case shows that every disturbance of perceptivity of the higher tones was attended with a diminution of perception of speech and conduction of tones through the bones. The steady improvement of the perceptivity of the lower tones was of subordinate significance with regard to the perception of speech.

We learn from the examination of the conduction of the tones of the tuning forks through the bones, that the perceptivity of all the musical tones was impaired. As we suppose that an exudative process existed, it is not surprising that single tones of the same octave were sometimes perceived distinctly and sometimes but faintly. We can easily imagine that the inflammatory process did not involve and change all the nervous fibres in the same manner.

The variations of conduction through the bones can be easily explained by the variations of labyrinthine pressure.

In regard to the electrical examination and treatment of the ear, I have but little to say.

Hyperæsthesia, with reversion of the formula as found in this case, has no diagnostic value. It is, however, important in a therapeutical point of view. By

the action of the anode the whizzing noise was increased; the patient, therefore, was treated with the cathode exclusively. The cathode had only a palliative effect.

If after resuming the treatment a definite result should be accomplished, I will report it.

FOURTH CASE.—*Injury of the Organ of Hearing attended with Hæmorrhage from the Nose, Mouth, and both Ears. Probable Hæmorrhage into the Labyrinth. Double-sided Deafness as regards the Upper Half of the Musical Scale. Considerable Diminution of Hearing.*

In the battle of Belfort, a soldier of the fourth Baden infantry was grazed by a bullet in the parietal region, while standing near the edge of a wall 15' in height. He fell from the wall, head foremost, and lost his consciousness for a short time. When he recovered his senses, he bled profusely from the mouth, nose, and both auditory canals. Later, otorrhœa appeared on both sides, and the hearing became so considerably impaired that the patient could only understand speech in his immediate vicinity. He was incessantly tormented by noises in both ears.

On examination, September 17, 1871, I found the patient in the following condition:—

Both external auditory canals normal. The drumheads equally changed on both sides. They were considerably retracted, and showed cicatrices, severally of the size of a pin's head, in the posterior inferior quadrants. The cicatrices changed after the air-douche. Inflation by Politzer's method had no influence upon the acuity of hearing. (The patient stated that a physician had employed the catheter a long time without good result.)

Hearing distance 2' for speech on either side; the ticking of the watch was not perceived by conduction through the bones. C' and C'' were perceived through the bones of the head, but the patient was unable to localize these tones with his ears open. On closing either the right ear or the left the patient could localize them. The examin-

ation with the piano showed that at the same distance the lower half of the musical scale was perceived distinctly, the upper half not at all. The patient did not submit to treatment; he merely wished to obtain a certificate of his condition.

Aside from the traumatic laceration of the drumheads and the subsequent cicatrization, this case is characterized by a hæmorrhage into the labyrinth, and is analogous to the case which I described in the preceding number of these Archives. This hæmorrhage may have involved chiefly those nervous fibres which transmit the high musical tones. Though it must be conceded that this case is not typical on account of the co-existing changes in the drumheads, it is nevertheless important in regard to the question as to whether the perceptivity of high tones in ear patients has any bearing upon the prognosis.

Considering that the injury had existed eight months, it seemed to me very improbable that an improvement would take place.

In the following cases no musical tones were heard. Hearing was completely abolished.

FIFTH CASE.—*Meningitis—Deafness as regards all the Musical Tones—Permanent total Deafness.*

E. G., aged 12, brought me the following history written by Dr. Janser :—

“The daughter of Mr. G. was attacked two months ago with high fever, violent headache, pain and stiffness in the nape of the neck, great restlessness and vomiting. On the evening of the first day of the disease the temperature in the axilla was 39.5°C . ; the pulse 110. Leeches were immediately applied to both mastoid processes ; $\frac{1}{2}$ gr.

of calomel was given every two hours and cold applications were incessantly made to the head. During the following four days the patient was comatose, sighed very much, tossed violently in bed. On the seventh day the temperature fell to 38°C . ; consciousness returned, but the stiffness and pain in the nape of the neck, and the headache, continued. When the fever had abated, the calomel was discontinued, indifferent infusions were administered, a blister was applied to the nape of the neck, and the surface kept open a long time. When the consciousness of the child had returned, it became quite evident that her hearing had become considerably impaired by the disease."

The administration of iodide of potassium, the application of the constant current gave no good result. No formula was found. The patient stated that during the passage of the current she heard a whistle in her head.

SIXTH CASE.—*Complete double-sided Deafness, depending upon Various Causes :—Syphilis, Rheumatism, and Concussion of the Organ of Hearing by Shooting—Complete Deafness as Regards all the Tones of the Musical Scale—Paradoxical Reaction according to Brenner.*

E. E., of London, consulted me on September 18, 1871. The patient was a merchant, and 47 years of age. In his family there is no hereditary tendency to diseases of the ear. He stated that he had suffered from secondary syphilis from 1841 till 1851, and that in later years he had caught cold repeatedly on his voyages to Sweden. In consequence of these exposures he suffered from chronic coryza, pain and swelling of various joints. The physicians could not agree as to the nature of the articular affection. When I examined him he had a considerable swelling of the left knee and a smaller swelling of the right wrist. These swellings were neither spontaneously painful nor tender on pressure.

In regard to the duration of the aural affection the patient stated that his hearing, especially on the left side, had not been normal for a long time. He suffered a material impairment of hearing in 1870, when he unexpectedly found himself on a square on which guns were fired in honor of the birthday of the queen. Four months ago he still could follow the conversation with a single person in close vicinity.

Since three months he has lost his hearing completely without an assignable cause. He was treated with injections into the middle ear; iodide of potassium was administered. The patient never had otorrhœa; he never suffered pain in his ears. He complained of continuous subjective noises of various kinds. "On the right side the noise resembles, sometimes the rolling of a wagon over a badly paved street, sometimes the noise of a regularly working steam engine, sometimes the drumming of military music, and on the left side it is either like the quick ringing of little bells or the singing of a canary-bird. I often asked my wife whether a canary-bird was in the room."

On examination I found both auditory canals and drumheads normal; the tubes permeable. The hearing was completely abolished for speech, watch, and musical tones. Through the double otoscope the tones of the tuning forks vibrating on the bones of the head were heard with equal distinctness on either side. The patient still heard the beats of a metronome at 2' with his right ear, at 5, with his left ear.

With the constant current (12 Siemens-Halske's elements) I found the so-called paradoxical reaction of Brenner on both sides. The patient described the subjective auditory sensations produced by the current, as resembling the sounds of a child's trumpet. The constant current was applied for two weeks without producing an effect either upon the deafness or the subjective noises.

SEVENTH CASE. — *Early Impairment of Hearing by double-sided Otorrhœa.—Subsequent Complete Deafness in consequence of Repeated Attacks of so-called Ménière's Disease. — Paradoxical Reaction.*

Mr. R. suffered in early infancy from scarlet fever. In the course of this disease he was attacked with pain in his ears, followed by otorrhœa, of which he still suffers. His hearing became impaired. Six years ago it was still sufficiently good to enable him to follow, without difficulty, every conversation in close vicinity. Without an assignable cause he was at that time suddenly attacked with vertigo and vomiting. These attacks recurred several times, the last time in January, 1871. Every attack diminished his hearing, the last destroyed it completely.

On examination, both drumheads appear sunken, greyish red, and

thickened,—the short processes only are distinctly visible. The drum-heads are slightly covered with pus, either having a perforation of the size of a pin's head in its postero-superior quadrant. The functional examination showed the same condition as in the preceding case.

The paradoxical reaction of both auditory nerves appeared with six elements. The air-douche showed the middle ear permeable on both sides but produced no effect upon the hearing. I did not treat this patient.

In considering the facts observed in the first four cases we find that, upon the whole, they correspond with our knowledge of the significance of the higher musical tones in relation to the perception of speech.

The examination was made with a piano of seven octaves. The human speech comprises eight octaves.* The higher tones appear of greater importance for the understanding of speech than the lower tones. This observation corresponds with the physiological facts as regards the pitch of the single vowels and consonants of which the human speech is composed.†

Aside from their diagnostic value, the cases reported in this paper, are of interest to the aurist in regard to prognosis. In many cases of so-called "nervous affection of the ear," the question as to whether the patient perceives the higher musical tones distinctly, faintly, or

* "The limits of human speech are in a certain degree arithmetically definable; R, with 16 vibrations in a second, being the deepest tone, and S, with 4032 vibrations, the highest. The lowest tone of speech is musically expressed by subcontra C, —C or C², its highest approximatively by c'. Speech thus comprises 8 octaves."—Oscar Wolf. *Sprache und Ohr*. p. 72.

† See Helmholtz. *Die Lehre von den Tonempfindungen*. 3 Ausgabe; and Wolf, l. c.

not at all, may furnish us with a clue as to the probable degree of recovery of hearing.

On observing additional cases we may be enabled to define the exact limit at which we can dispense with the low tones without noticing an impairment of the perception of speech.

ON THE CHANGES IN THE RETINA AND
LABYRINTH IN A CASE OF FIBRO-
SARCOMA OF THE AUDITORY
NERVE.

BY PROF. ARTHUR BOETTCHER, OF DORPAT.

(With Plates I. & II.)

‡ (Translated from the German by Dr. Charles J. Kipp, of Newark, N. J.)

THE following case of tumor of the brain, with consecutive blindness and loss of hearing, with perverse perception of taste, and other functional disturbances of which I shall not here speak, is by no means an uncommon one; but so closely resembles several cases already published that it might almost be identified with them. Whilst the fact that hearing and vision suffer or are entirely destroyed during the growth of such tumors is generally known, the anatomical changes occurring in both nerves of special sense are as yet not clearly understood. Concerning the affection in the retina, which has of late been repeatedly observed in the living with the ophthalmoscope, we find that the statements of the morbid changes differ greatly; whereas the minute changes in the labyrinth have heretofore entirely escaped investigation.

I would not, therefore, let this opportunity pass without inquiring into the conditions on which the disturbances of sight and hearing depend. The results obtained with regard to the former differ in many points from those of my predecessors ; and with reference to the latter, I may say that this communication forms the beginning of a pathological histology of the cochlea. Having premised the above to elicit the interest of the reader for my observations, I shall now proceed to the description of the case. The patient was under the care of Prof. von Oettingen, who has kindly furnished me with the following history :—

Chr. Levinson, a Jewess, 21 years of age, of medium stature and slender form, but with well-developed muscles, was admitted to the Ophthalmic Hospital on the 18th of November, 1870.

The eyes were staring ; the functions of the ocular muscles were, however, normal. Both eyes were totally blind ; the pupils were dilated ad maximum, and responded only moderately to light. The facial nerve of left side was paralyzed in all its ramifications ; the lower half of scleral conjunctiva was hyperæmic and the corresponding portion of cornea superficially inflamed, in consequence of incomplete closure of lids. The tongue was protruded in a straight line. The uvula and soft palate were in their normal positions. There was complete deafness of left ear. It is not known whether there were subjective sensations of sound. The hearing of right ear seemed also impaired, but as on examination it was found that the hearing distance was but slightly shortened, it seems probable that this was due to a certain dulness of the psychical functions. No organic change in organs of hearing could be demonstrated. An extremely tormenting headache, more especially of left side, was almost constantly present ; and there was intercurrent pain in ramifications of sensitive branches of fifth pair of left side. The integument was equally sensitive on both sides of face. Patient complained especially of a bitter taste and a burning sensation in mouth ;

also of difficulty in swallowing and loss of appetite. The sensibility and the mobility appeared to be unimpaired on either side of the body ; at request, movements of separate limbs were executed without hesitation, but the faculty to combine movements for a definite purpose was impaired in a high degree. When trying to walk alone she reeled so much that she was in danger of falling if not supported, and the lower extremities moved totteringly. The palpation of the head and spine disclosed nothing abnormal, and no point of special tenderness on the former could be discovered by percussion.

The ophthalmoscope revealed nearly the same appearances in both eyes ; the refracting media clear, with the exception of a part of left cornea (see above). The optic papilla markedly white and without a definite boundary ; the surrounding retina being of the same color and infiltrated in a concentric ring, the diameter of which was about three times that of the optic papilla. The level of optic nerve entrance was somewhat raised ; the retinal vessels, as far as the infiltration went, were here and there covered. The veins were very tortuous, even to a greater distance ; the arteries were but little changed.

Excepting a slowness in answering, the psychical functions had not suffered. Patient had been constipated for nine days, and had unmistakable symptoms of a chronic gastric catarrh. The menses had been suppressed for a year. The functions of the other internal organs were all well performed. The secretion of urine was also normal, but its evacuation was difficult and somewhat slow. Pulse and temperature were normal.

The patient's parents were both healthy, and she herself had enjoyed good health until her 19th year. Two years ago she was attacked with severe headache and vomiting without any assignable cause, and since that time she has repeatedly suffered from similar attacks. Once she took a severe cold and at the same time had a violent fit of anger ; on the following morning she awoke with great headache, blindness and deafness on the left side, and swelling and distortion of left half of face. At the same time she felt a weakness of left side. While these phenomena persisted, the *right* eye likewise became gradually blind. Five months ago she resorted to sulphur baths, but without benefit. Since that time there has been no return of the menses, and twitchings have been observed from time to time in the *right* arm.

There could be no doubt that this was an intra-cranial affection, and it could as little be doubted that its seat was mainly on the left side of the basis cranii; that the pathological product was in the posterior or middle fossa of the cranium, and suspended the functions of the facial and auditory nerves, at the same time irritating the trifacial, and perhaps the glossopharyngeal and pneumogastric nerves, if the symptoms above mentioned were not exclusively due to the gastric catarrh. It was more difficult to explain the participation of the tracts of the optic nerves, as they are situated more distantly in the anterior portion of the middle fossa. The ophthalmoscopic appearances pointed toward a neuritis optici descendens, lacking the characteristic features of the choked papilla, dependent on an intra-cranial tumor, and consequent increase of intra-cranial pressure. Lastly, there could be no doubt that the cerebellum and, perhaps, the pons Varolii, suffered likewise from the disease. Extremely difficult, on the other hand, was the definition of the nature of the pathological process. Experience would lead us to the diagnosis of a pseudoplasm, which by its steady growth on the base of the skull, produced the symptom above mentioned. But this diagnosis was not strengthened by the history of the case, according to which essential symptoms of paralysis had appeared suddenly over night. We therefore thought that we had possibly to deal with an intra-cranial extravasation, which had caused the inflammatory processes at the base of the skull and in the neighboring nervous parts. This supposition had to be kept in view the more, as it

held out at least some hope of benefit from treatment.

The subsequent history of the case up to the time of death, April 3, and the treatment adopted, were briefly as follows: The gastric catarrh was relieved by a careful diet, the irregularities of the digestion by the use of soda-water, rhubarb, extract of colocynth, and clysmata, whilst intercurrent attacks of diarrhœa yielded best to the administration of tannin. By the use of hot footbaths and sinapisms we succeeded in bringing on the menses. Inunctions of ungt. hydrarg., after Sigmund's method, were ordered, and a seton applied to the back of the neck. During this treatment, which was well borne, and completed without the occurrence of salivation, the application of an ice-bladder to the head was found to be the only means of relieving the headache. The inunction treatment was concluded November 20, after thirty inunctions of $\mathfrak{z}$ j had been made. On some days during this treatment the patient was in a somewhat more comfortable condition; but this was entirely due to the mitigation of the headache and indigestion. In the mean time the symptoms of irritation increased, the headache became severer, and vomiting, transient epileptical convulsions and increased temperature were observed. Some relief was obtained from the application of leeches to the mastoid process. After the completion of the inunction treatment, iodide of potassium was given for two weeks, but no improvement followed; nor were the symptoms of irritation mitigated by the use of the bromide of potassium; and the hydrate of chloral had as little effect on the insomnia.

In the early part of January we observed with the ophthalmoscope increased swelling of the disc, and also found that the infiltration in the adjacent retina had extended, although it still was circumscribed; but no trace of retinal extravasation could be observed.

Considering the utter inefficiency of the treatment pursued, and the progress of all the symptoms, it was now quite clear that we were dealing with a tumor at the base of the brain. From that time the treatment was entirely symptomatic. The superficial keratitis improved somewhat under the use of astringent collyria and the bandage. About the end of March, the above-mentioned phenomena of increased cerebral irritation became constant and more violent.

Shortly after a severe attack of vomiting there was a complete cessation of respiration and pulsation, with total unconsciousness; but this attack, the cause of which could not be ascertained, soon passed over. On the first of April, the patient was attacked with facial erysipelas, accompanied with albuminuria and great elevation of bodily temperature. Coma soon supervened, and death occurred on the third of April, while the erysipelas was at its height.

Autopsy.—Exactly twenty-four hours after death, I made a post-mortem examination, the results of which were in substance as follows:—

Body well nourished, rigor mortis marked, integument remarkably pale; but few suggillations on the back. Adipose tissue abundant, especially in abdominal walls; muscles dark and dry.

Face bloated, especially lids of left eye greatly infiltrated.

The moderately thick skull-cap of compact structure; in the os frontis, exactly in the median line, was a depression of the size of a pea, which almost perforated the bone, caused by a Pacchionian granulation. In its posterior part the skull seemed unsymmetrical, as the part corresponding to the right crus of the lambdoid suture appeared somewhat flatter than that opposite; but the suture itself was well preserved in that place.*

The longitudinal sinus contained dark fluid blood, but no coagula. The dura mater thin and tense, but injected. The soft membrane frail and likewise tense;

* In view of the fact that the suture was wholly preserved, and that a tumor was found within the skull posteriorly and to the left, which, judging from the history of the case, had been growing for about two years, the want of symmetry should not be referred to a flattening of the right side, but rather to a gradual elevation of the left, the result of intra-cranial pressure.

its veins were moderately filled. The convolutions of cerebrum were greatly flattened, especially on both sides of the longitudinal sinus. After the removal of the brain, more than an ounce of serum was found in the posterior fossa of the skull. At the base, the finer vessels of the pia mater were more injected. Below the bulging tentorium, and immediately to the left of the pons, was seated a tumor the size of a small apple, which lay against the posterior surface of the petrous bone, and extended into the porus acusticus int., at the entrance of which it had to be severed. In its general outline it was nearly spherical, yet at the same time somewhat nodular; it appeared to be covered by a continuation of the pia mater. On the cut surface it showed a white coloration, a scanty amount of blood, and a fleshy consistence throughout. When pressed upon it yielded a quantity of clear, somewhat sanguinolent fluid. Its largest diameter measured 4.5 cm.; its smallest, 4 cm.*

This tumor was so seated between the pons and the medulla oblongata on one side, and the left hemisphere of the cerebellum on the other, that one-half of it appeared surrounded by the brain, whilst the other half projected freely downward. Where its inner surface was in contact with the pons, the pons was flattened laterally, and its left half was greatly atrophied. In consequence of this, its longitudinal groove (sulcus basilaris) did not coincide with the median line, but was nearer to its left edge, and resumed its usual position only in the posterior portion of the pons. By this the pons had gained in length at the point of compression,

and at this point its posterior lower edge was farther depressed (Fig. 1, Table I.). The medulla oblongata had taken an oblique position, was displaced to the right and showed two unsymmetrical halves. Very conspicuous was the great projection of the left olive, whilst the right was slender and thin.

At its outer and posterior surface the tumor was embraced by the left hemisphere of the cerebellum, into which it had dug a semilunar cavity. The flocculus and the greater part of the tonsilla had been destroyed, and the adjoining parts of the other lobes had been excavated by the tumor; of the tonsilla only the most posterior and superior part was preserved, but greatly crowded upward. The floor of the cavity in which the tumor was situated, was formed by the crura cerebelli, which seemed greatly enlarged and stretched outward. The wall of the entire cavity was smooth and lined by the pia mater; between it and the tumor were found only a few communicating vessels with delicate cords of connective tissue, so that it could be easily and completely detached.

Upon closer examination, made in part after the preparation had been hardened in alcohol, it was found that the common trunk of the auditory and facial nerves, from the point where it appeared behind the pons, was contracted into a thin cord, more than 2 cm. long, which was inserted into the inner surface of the anterior portion of the tumor (Fig. 1, Table I.). To the unaided eye, this cord appears composed of several fine threads. Diagonally opposite, in an outward and forward direction, was the point at which the tumor, at its

entrance into the porus acusticus int., had been divided. The root of the trifacial nerve, which at the autopsy was found to be totally compressed, could not be demonstrated in the hardened preparation. Unfortunately, no examination was made of the nerve in its further course in the body.

The fibres of the trochlear nerve presented no alteration under the microscope. The glosso-pharyngeal and pneumogastric nerves were compressed by the tumor ; their roots were proportionately thin, and had undergone fatty degeneration to a considerable extent. Of the microscopical characteristics of the auditory and facial nerves, I shall speak further on : those of the hypoglossal nerve were unaltered.

The fourth ventricle was dilated, its ependyma was uniformly thickened, and the elevations and depressions of the brain substance beneath it were completely leveled ; the striæ medullares had disappeared entirely ; the corpora restiforma were atrophied, and the calamus scriptorius was transformed into a simple funnel. Both olivary bodies, but more especially that of the left side, were transformed into broad pouches ; the velum medullare, with the lingula, was atrophied ; the aquæductus Sylvii, compressed. The crura cerebelli were flattened correspondingly with the dilatation of the fourth ventricle ; those of the right side were of a more roundish form and measured 2 cm. in an oblique direction (antero-posteriorly) ; but on the left side the crura cerebelli ad pontem, ad corpora quadrigemina, and ad medullam oblongatam had been transformed into a completely flat cord, 3 cm. broad, which, as was

above stated, was also seen from below, covering the tumor.

The third ventricle was likewise greatly dilated, its floor was broad and gaping; the tuber cinereum was especially dilated, in consequence of which the floor of the cavity was so much displaced forward and laterally that it occupied almost the entire breadth of the chiasma nerv. opt., and had somewhat flattened its upper surface.

The lateral ventricles were no less dilated, and the left, principally its posterior horn, was still more enlarged; each of these contained about an ounce of serum. The fornix and septum pellucidum were firm and tenacious; the vessels of the choroid plexus were moderately filled; the ependyma was uniformly smooth and shining. The corpora striata and thalami optici were anæmic and relaxed, and the depression between them, together with the tænia semicircularis, were effaced; the pineal gland contained some chalk; the corpora quadrigemina were pale and flabby.

The white matter of the cerebrum was somewhat hyperæmic, but likewise flabby; the cortical layer, very thin at some points, was slightly injected.

The lungs contained air in every part; hypostatic hyperæmia was found in their lower and posterior portions; the left was strongly adherent to the wall of the chest.

The moderately large heart contained much dark fluid blood, with œdematous lardaceous coagula in the right ventricle. The edges of the mitral valve were thickened. The muscular tissue firm; that of the left

side of a brownish red color. The calibre of aorta was narrow.

With regard to the abdominal organs I will only mention, that the stomach presented the signs of a very severe chronic catarrh which, as it extended into the ilium, gradually diminished in severity. On the outer surface of the lower third of the duodenum was found a fibrous tumor of the size of a hazel-nut, which had caused a funnel-shaped retraction of the inner surface of the intestine. The liver was moderately congested, and the spleen somewhat enlarged by recent swelling. The kidneys were hyperæmic, the ovaries large, and their surfaces studded with numerous follicles, part of which were hydropical.

*Examination of the Optic Nerves, the Chiasm and the Retina.**—On examination of the trunks of the optic nerves, their intraorbital portions appeared unaltered to the naked eye; but there was a conspicuous thickening of their outer sheaths,† which at different points measured 0.65 mm., 0.75 mm. and 0.9 mm. The subvaginal space (Schwalbe) was enlarged. The optic nerve was therefore but loosely invested by its outer sheath.

The microscope showed no pathological change of any importance in the nerve fibres. What alone seemed worth mentioning was a certain pallor of the fascicles nearest to the inner sheath, when examined by transmit-

* Previous to the examination, the preparation had been lying for three weeks in Müller's fluid, and subsequently for a few days in alcohol. Only the posterior segments of the eyeballs had been removed from the body.

† The normal thickness of the outer sheath of the optic nerve is stated to be 0.5 mm. (Henle).

ted light, although a distinct marginal zone could not be discovered by the unaided eye. This pallor was due to atrophy of the medullary sheaths of the nerves. The number and the extent of the portions thus affected were however so small, that they would probably have entirely escaped observation if the same process, but in a much higher degree, had not been found in the more central portions of the optic nerve.

To guard against overlooking slighter alterations I treated transverse and longitudinal sections with different reagents. By steeping the preparation in chloride of gold, the bundles of nervous fibres were intensely colored. The axis cylinders were made plainly visible by carmine, and the number and the arrangement of the nuclei in the interstitial connective tissue were examined with aniline, which renders the nuclei very visible. The presence of amyloid bodies was tested with iodine and sulphuric acid. The result of all these examinations was negative, no pathological products (granular bodies, proliferation of nuclei, corpuscula amylacea) nor changes in the appearance of the nervous fibres being recognizable, if we except the trifling affections above mentioned.

But a different condition was found in the chiasm and the first portions of the optic nerves.

As stated in the report of the autopsy, the chiasma was slightly compressed at its upper surface, and the adjacent portions of the optic nerves were somewhat flatter than usual. Corresponding with this, there was seen on the upper surface, where the flattening had occurred, a fine transparent stripe, plainly visible to the

naked eye, in transverse sections of the hardened preparation (Fig. 2 A, b, Tab. I.). At this place the nerve fibres had disappeared and in their stead was seen a delicate connective tissue, transverse sections of which showed a fine network (Fig. 2 B a), interspersed with nuclei (B c and C b), and connected with the sheath.

From this network similar transparent filaments, growing gradually thinner, radiated in all directions of the transverse section, between the bundles of the dark-bordered nerve fibres. In addition to this, there was seen around the entire periphery, immediately below the inner sheath, a narrow zone, in which the optic nerves were degenerated in a similar manner.

In these places (which, as is well known, are of a gray color in the fresh state) were everywhere found numerous corpuscula amylacea, which became intensely blue by iodine and sulphuric acid. In the dark portions of the transverse section, where the nerve fibres were still recognizable and opaque (Fig. 2 A c), great quantities of granular bodies were seen scattered amongst the nervous fibres, with but proportionally few amyloid bodies.

The morbid process was therefore very marked in the chiasma, but extended, gradually diminishing, only 0.5 cm. along the optic nerve. At this point the amyloid and granular bodies disappeared, but at the boundary of the morbid process the medullary sheaths of the nerve fibres showed a finely granular fatty degeneration, the nature of which could not be determined in the hardened preparation.

A propagation of the morbid process in the cranial

cavity to the retina did not, it seems to me, take place, as the only alteration found in the optic nerve was the circumscribed atrophy at the periphery above mentioned.

Alterations of more importance began to appear at the lamina cribrosa. In longitudinal sections of the optic nerves which passed through the papilla, a very great dilatation of the subvaginal space was very conspicuous. Its blind end was distended like a bag, and its retiform connective tissue framework unusually developed. The trabeculæ of the lamina cribrosa also appeared thicker, and their sections more distinctly striated than usual; it was, however, very difficult to say whether any of the nervous fibres were atrophied or totally destroyed. A part of the nervous fibres could be distinctly seen passing through the lamina cribrosa into the papilla. From the thickness and the close aggregation of the transverse connective tissue fascicles in the lamina cribrosa, I think that the nervous fibres entered the eye in a smaller quantity than in the physiological condition. The changes in the papilla nervi optici were more marked. The papilla was considerably raised, a section passing through its centre projecting on one side 0.85 mm., and on the opposite side 0.95 mm. above the choroidal foramen, without sloping abruptly towards the level of the retina. The central excavation was funnel-shaped and comparatively deep, but did not reach the level of the choroid.

The central vessels of the papilla divided into a greater number of branches before they reached the bottom of the funnel. Their walls were thickened, and both in trans-

verse and longitudinal sections they were surrounded by a gaping light space, which I can take only for a dilated lymphatic sheath; around this was a dense mesh of fibrillæ, filling, as it were, the intervals between the vessels. In these fibrillæ, running in various directions, there were embedded numerous nuclei, principally at the bottom of the central excavation, where the retinal vessels divide. But at the prominent points of the papilla I sought in vain for the parallel lines of nervous fibres proceeding in a definite direction; in their place there was a delicate network of interlacing fibres. I therefore think that I am not mistaken in asserting that the superficial layer of the optic papilla was mainly composed of proliferating interstitial connective tissue, accompanying the blood-vessels. Only in the deeper layers of the papilla were found parallel fascicles of fibres bending over into the retina; of the relations of which to the remaining layer of the retina I shall speak hereafter. But first I may mention that no distinct boundary existed between the apparently thickened connective-tissue layers and the fibrous tracts (nervous fibres?) bending over into the retina. I obtained no decisive results from staining longitudinal sections of the optic nerve with chloride of gold.

The retina* showed a marked thickening round the optic disk. At a distance of about 1 mm. from the disk, the retina† still measured 0.6 mm. in thickness, but soon

* The following description of the changes in the retina is based exclusively on the examination of the left eye, as on comparison it was found that those of the right were essentially the same.

† According to Henle, the thickness of the retina in a normal eye, at the disk, measures 0.3—0.4 mm., and 2 mm. further on, only 0.2 mm. (*Eingeweidelehre*, p. 637.)

became so attenuated that 3 mm. farther towards the equator its transverse diameter was only 0.3 mm. (Fig. 3.) The arrangement of the different layers of the retina will be spoken of after the more conspicuous alterations have been described.

In the first place was to be mentioned the extraordinary development of the radial fibres, which appeared exceedingly thick and shining, having enlarged, markedly striated ends, some of which contained nuclei.

Most of these did not insert themselves into the *limitans interna*, but communicated with one another, forming strong arches, which caused an apparent increase of the thickness of the limiting membrane. (Fig. 4.) This excessive development was visible not only at their inner ends, but in their course through the outer layers of the retina. These fibres were most conspicuous in the immediate neighborhood of the optic disk, where the retina was thickest. Transverse sections of this region discovered at once the entire course of the radial fibres from the inner limiting membranes to the outer. The boundaries of the layers of the retina were there effaced, the two granular layers principally, had coalesced, and under low powers showed a radiating striation, resulting from the strongly marked transverse fibres. (Fig. 3 k.) This condition was no longer observed a short distance from the papilla (Fig. 3), when the different layers of the retina could be clearly distinguished, and showed the following alterations :

1. The layer of nervous fibres did not reach the inner limiting membrane, but was separated from it by an appreciable space (on an average 0.03 mm.). In

the section parallel to the fibrous layer a radiating striation was seen (Fig. 3 a), in which the broadened ends of the supporting fibres could be recognized with the higher powers. Sections at right angles to the fibre bundles (Fig. 5) showed the same striation, and, besides, a space which lay between the inner limiting membrane and the nervous bundles ; this was bounded by the arches of the thickened radial fibres, and was either empty or wholly or partially filled with a very finely-granular substance (Fig. 4*b*). This substance had the appearance of a spongy coagulum of an albuminous fluid ; an examination with reagents was impracticable, on account of its small quantity.

Henle and Merkel* observed similar gaps between the inner limiting membrane and the layer of nervous fibres in the sheep, and interpreted them as lymphatic spaces ; Dr. Rosenberg informs me he has occasionally observed them in animals killed by strangulation. This observation strongly supports the assumption that the increased intra-cranial pressure fills a lymphatic space of the retina, and that the very same cause, the existence of which was proved by the autopsy, had separated the layer of nervous fibres from the inner limiting membrane in this pathological specimen. A comparison of my preparations with those of Dr. Rosenberg and with the drawings given by Henle and Merkel shows that they differ in this, that in my preparations the ends of the supporting fibres are more coalescent, and form rather thick arches, from which the

* *Zeitschrift für Rat. Med.*, Vol. 34, p. 62, Tab. iv., Fig. 11 and 12.

nervous fibres are more remote. The long duration of the morbid process (the augmented intra-cranial pressure) must doubtless be taken into consideration. This morbid process seems to have had some influence on the nervous fibres. I measured many nervous fibre bundles, and found their sections 0.01, 0.02, 0.03 mm. by 0.02, 0.03 mm.; but a great many of them were round, having a diameter of 0.01, 0.02 mm. If we compare with this the examinations of Henle, who states their width at 0.025 mm. and their height at 0.015 mm., it seems indeed that in our case the size had been diminished.

From a merely anatomical examination of longitudinal (Fig. 3 *b*) as well as transverse sections (Fig. 4 *c*) of the layer of parallel bundles, we must nevertheless assume that the greater part of the nerve fibres had been preserved. An entirely different result was obtained from staining with chloride of gold. That which appeared to be a layer of nervous fibres was absolutely not stained by this reagent, neither were the two granular layers affected by it; whereas both the molecular layers above all, and often alone, reduced the gold; and besides these, in other preparations the outer layer of fibres (inter-granular layer), and the cones of the bacillar layer were also stained intensely violet. From this is to be inferred that no nervous elements were represented in the fibre fascicles of the original nervous fibre layer, or that their number was so small that they could not be recognized by their color.

The same negative result was obtained from the chloride of gold treatment of the layer of nervous fibres in

the vicinity of the papilla (Fig. 3 b'), where its thickness, instead of 0.6 mm. in the physiological condition, measured only 0.2 mm. From an anatomical point of view we also could not fail to recognize here, in the vicinity of the blood-vessels (Fig. 3 v), which were provided with perivascular lymphatic spaces, reticulated, interlacing strata of proliferating connective tissue, merging gradually and without distinct boundary into the tracts of parallel fibres.

2. The ganglionic layer. In its stead only lacunæ were seen almost everywhere (Fig. 3 c, Fig. 5). Only after prolonged searching was I able to detect a few well-preserved multipolar cells. In the region of the yellow spot, however, I found some arranged in a row, and even two above each other. But the atrophy of this layer was doubtless nearly a complete one.

3. The granular layers, in which the thickening of the retina was most marked, and the bacillar layer were distinguished by perfect preservation of their elementary parts. A noteworthy change in the neighborhood of the papilla was, as above stated, the continuance of the thickened radial fibres from the inner limiting membrane to the outer, which determined the arrangement of the granules. The transverse striation resulting therefrom was especially marked in the inner granular layer (Fig. 3 k). Between the columns of radiating fibres, at pretty regular intervals, were seen lacunæ which made the impression upon me that the structural elements had been crowded apart by serous exudation (œdema.) In the places where no lacunæ were the granules appeared much more sparsely strown, which made the whole

layer, by transmitted light, appear greatly lighter than usual. This condition disappeared at some distance from the papilla (Fig. 3 *e*).

4. The outer fibrous layer (inter-granular layer) was, as usual, of varying thickness (Fig. 3 *f*, Fig. 5 *f*), and entirely absent in the places near the papilla, just described (Fig. 3 *k*). There the outer molecular layer was likewise absent, whereas the inner was preserved (Fig. 3 *d'*), but less distinctly bounded, and changed in appearance by the thickened radial fibres.

5. The rods and cones were everywhere well preserved.

In conclusion, I beg leave to add a summary of the relations of the different layers of the retina to each other, according to the section represented in Fig. 3.

The following are the measurements of the different layers at a distance of 1 mm. from the papilla:—

The layer of nerve fibres.....	0.2 mm.	(Fig. 3 <i>b'</i>)
The inner molecular layer.....	0.03 mm.	“ <i>d'</i>)
The coalesced granular layer.....	0.32 mm.	“ <i>k</i>)
The bacillar layers.....	0.05 mm.	“ <i>i</i>)
Thickness of retina.....	0.6 mm.	

At a point 3 mm. distant from the papilla we found:—

The distance between the membr. limit.

int. and the layer of nerve fibres.....	0.03 mm.	(Fig. 3 <i>a</i>)
The layer of nerve fibres.....	0.03 mm.	“ <i>b</i>)
The ganglionic layer.....	0.015 mm.	“ <i>c</i>)
The inner molecular layer.....	0.03 mm.	“ <i>d</i>)
The inner granular layer.....	0.07 mm.	“ <i>e</i>)
The outer fibrous layer (inter-granular layer).....	0.015 mm.	“ <i>f</i>)

The outer granular layer.....	0.06 mm.	Fig. g)
The bacillar layer.....	0.05 mm.	“ i)
Thickness of retina.....	0.3 mm.	

The regions of the retina in which the larger vessels ramify deserve a more special consideration. They were in general characterized by greater thickening than the surroundings. At the same time it was observed that the retina, after having been hardened and detached, had lost its uniform curvature on its outer surface along the course of the blood-vessels, where it presented a fold-like elevation, best seen in a transverse section (Fig. 5). Here the following changes had taken place:—

The larger vessels provided with a thick muscular coat (arteries) showed a light perivascular space, around which were concentric layers of fibrous connective tissue, the more external portions of which were gradually lost in the layers of the retina. Here the layer of nervous fibres was so greatly thickened that it measured more than half the diameter of the entire retina; the membr. limit. appeared raised in irregular nodules on the inner surface, whilst in an outward direction the morbid process extended deeply into the inner granular layer. The ganglionic and the inner molecular layers were absent in the immediate vicinity of the vessels. The radial fibres were uncommonly coarse and could readily be traced into the outer intergranular layer; there was, however, not the slightest regularity in their arrangement; they curved around the vessels and consequently appeared widely separated at one point, whilst they were closely pressed together at another. At the same

time each separate fibre was visible without interruption from its broadened end onward. Between them, the thickened layer of nerve fibres extended close up to the inner limiting membrane (Fig. 5), and was, therefore, not separated from the latter by a lymphatic space in the immediate vicinity of the blood-vessels. But this space became visible again on both sides a short distance from the vessels, where the radial fibres had a more regular arrangement, and the thickening of the layer of nervous fibres decreased; this decrease was so uniform on both sides that the diameter of the retina, which in the course of the vessels was augmented to 0.6 mm., sunk to 0.3 mm. at a distance of 3 mm. from the blood-vessels. (Fig. 5.)

What was the composition of these thickened strata of fibrous tissue surrounding the retinal vessels? Their arrangement was that of parallel bundles, a transverse section of which had the same appearance as that of normal fascicles. Chloride of gold produced no staining. The supposition of a numerical hyperplasia of nervous fibres could therefore not be substantiated, although the fibres in the thickened parts did not differ in their aspect from those of the normal thin layers. On the other hand it may be stated that on account of the negative reaction with the chloride of gold, the fibres of the thin layer also were degenerated.

With a view of arriving at a more exact decision in regard to the surroundings of the vessels, than is possible to form from transverse sections, I made surface sections of the retina, which were carried through the thick ridge extending along the vessels. They

showed very plainly that the bloodvessels were embedded in a thick layer of wavy, rigid, shining connective tissue fibres, arranged in bundles, between which were lacunæ containing round granulated nuclei, grouped either in rows or clusters. A hypertrophy of the nerve fibres was therefore entirely out of the question; on the contrary, the entire thickening of the fibrous layer and the surroundings of the blood-vessels was due to a proliferation of connective tissue.

Critical remarks on the above-described disturbances of vision.

From the preceding description it appears that with regard to the loss of vision, occurring in our case, two different centres of disease were found, which must be strictly kept apart. These are :—

1. The atrophy in the chiasma and the roots of the optic nerves, produced by pressure of the tuber cinereum, swollen in the shape of a bladder. In the superior portion of the former was found a localized gray degeneration, and in the deeper parts was observed a considerable quantity of granular bodies amongst the partly conserved nervous fibres.

Türk* was the first to call attention to an affection of the same nature in the chiasma, caused by dilatation of the third ventricle in hydrocephalus; a more precise determination of the conditions leading in this way to amaurosis is, however, still needed. Not every case of hydrocephalus with great intra-cranial pressure produces

* Zeitschrift der Wiener Gesellschaft der Aerzte. 8. Jahrgang, 1852, p. 300.

a protrusion of the tuber cinereum, nor does blindness occur in every severe case of hydrocephalus internus.

From an analysis of my case with regard to this point, it appears to me to be of importance with reference to the dilatation of the third ventricle and the conditions resulting therefrom, to notice (as I have previously more particularly explained) that the tumor had caused a compression of the aquæductus Sylvii; and had also completely or partially obstructed the three anterior ventricles. In this condition the accumulating contents of the ventricles could probably not find an outlet, and an increase of pressure be obviated by a distribution of the fluid. We can at least not reject the supposition that probably only under certain conditions, similar to the above, an affection of the chiasma results from the protrusion of the tuber cinereum, but less by increased intra-cranial tension in general: though this subject evidently requires a more exact inquiry, and a more thorough study of the effects produced by local intra-cranial affections on other regions of the brain. I cannot here refrain from mentioning some important facts collected by Lebert.* “The optic and the auditory nerves are frequently altered at the same time, but if only one of them suffers, it is by preference the auditory.” (P. 486.) “Usually the power of hearing was gradually lost on one or both sides, and soon complete deafness supervened; only three times was this sense alone affected, eight times simultaneously with the sense of sight, and three times with disturbances of several

* On Cancer and the Tumors of the Brain and Meninges mistaken for Cancer. Virchow's Archiv, Vol. III.

nerves of special sense. If, therefore, deafness is gradually produced in cases of continuous headache, we must consider the possible existence of a tumor of the brain. But then the diagnosis would still be very doubtful, but if at the same time the sense of sight or still other senses should suffer, we must think of a tumor in the vicinity of the petrous bones, extending further forward." (P. 510.)

Is there any other explanation for a series of disturbances of the senses, following one another with such precision as to justify us in diagnosticating with a good deal of probability a tumor in the region of the petrous bones? A general increase of intra-cranial tension does not explain it, but there must be definite local causes for the degeneration of the chiasma, apart from those cases in which the tumor reaches the chiasma.

2. The changes in the Retina. They were independent of the atrophy of the chiasma. The intraorbital portion of the optic nerves was found almost unchanged. In it was seen neither an atrophy with fat granules or amyloid bodies, nor a proliferation of the interstitial connective tissue. An extension of the degeneration of the chiasma to the peripheric end of the nerve was, therefore, not present, nor could a neuritis descendens be observed.

And yet the changes in the retina, as previously seen by the ophthalmoscope, were very great. We found that the thickness of the retina in the close vicinity of the papilla was increased to about twice its normal diameter, and noticed particularly a proliferation of the granular layer, a thickened connective tissue layer sur-

rounding the vessels, destruction of the layer of nervous fibres, separation of the layer of nervous fibres from the membrana limitans, and an excessive development of the radial fibres.

All these alterations indicate a chronic affection, which may have been of an inflammatory nature (Retinitis). But the inflammation has, at all events, not been transmitted to the retina from a central focus, although there can be no doubt that the tumor of the brain was the cause of it.

But in what way was it developed? From the observation of analogous cases, we must, above all, take into consideration the intra-cranial pressure, which in this case was evidently greatly increased, as proved by the distention of the meninges, the flattening of the convolutions on the convexity of the great hemispheres, and by the dilatation of the ventricles. According to the theory first advanced by Von Graefe, and heretofore generally accepted, we have to deal in such cases with compression of the vena ophthalmica, or the cavernous sinus, as consequence of which we see a choked papilla and different changes in the retina. This explanation was refuted, not long ago, by Sese-
mann,* who demonstrated that a compression of the sinus cavernosus or the vena ophthalmica could not produce stagnation so long as the flow of blood from this into the vena facialis was not impeded, and that, on the other hand, a compression of the sinus cavernosus was by no means an easy experiment, in which he, at least,

* Reichert's und Du Bois's Archiv, 1869, p. 154.

had never succeeded. It is evident that the development of the choked papilla, and the advanced alterations in the retina, seen in our case, were dependent on other causes than an impeded evacuation of the ophthalmic vein.

When I first saw the considerable dilatation of the space between the outer and inner sheaths of the optic nerve, and at the same time found a marked thickening of the outer sheath, I no longer doubted that the augmented intra-cranial tension had extended from the arachnoidal space to this point, which assumption is corroborated by Schwalbe's* well-known experiments on the connection between the "subvaginal" lymphatic space and the arachnoidal cavity. But having, moreover, found a bag-like dilatation of the anterior end of the subvaginal space around the whole optic nerve, and an especially abundant development of the intravaginal connective-tissue network at this point, I believe that these conditions are the true cause of the alterations in the retina. The excessive filling and dilatation of the subvaginal space at its blind end, must result in strangulation of the retinal vessels in the region of the lamina cribrosa. The correctness of this proposition being conceded, it cannot be difficult to understand the alterations of the retina found at the autopsy, as well as the ophthalmoscopic appearances observed during life, though we cannot yet enter into a discussion of their details.

* Archiv für mikrosk. Anatomie, Vol. VI. p. 1.

Microscopical Examination of the Tumor, and the Changes produced in the Auditory and Facial Nerves and the Labyrinth.

It will be remembered that the tumor found within the skull was connected with the common trunk of the facial and the auditory nerves, which appeared as a white cord, 2 cm. long and 1 mm. thick, showing under the microscope medullary nervous fibres in all its bundles, but the medullary sheath was nowhere complete, clinging to the numerous free axis cylinders in the form of small scales, here in large patches, there in isolated places and in inconsiderable quantity. Although we do not forget that the specimen was examined only after it had been hardened, this great denudation of entire bundles of axis cylinders remains very extraordinary. All the fibres were colored intensely violet by the chloride of gold. Fatty degeneration of the fibres could not be seen in the specimen preserved in alcohol.

In the report of the autopsy it was stated that a portion of the tumor extended into the porus acusticus internus. We shall now examine this portion on account of the changes found in the labyrinth.

For the study of these alterations, I decalcified the whole labyrinth by a ten per cent. solution of hydrochloric acid, and divided it into fine sections, running in part through the axis of the cochlea and the inner meatus, in part parallel with the contents of the vestibule, when they formed the object of investigation.

Such sections, of which one is represented in Fig. 6, show well, on the one hand, how far the tumor reached,

and, on the other, the lesions of the labyrinth produced by it. With reference to the first, it was found that the inner auditory canal was dilated in every direction, and that its walls were irregular and undulating. The canal was completely filled by the tumor, which was in direct contact with the bone. The bone showed no trace of inflammation, its excavation being the result of simple atrophy from pressure.

A somewhat different condition was found at the bottom of the internal auditory canal, where the tumor was in contact with the base of the cochlea. Here the tumor bulged considerably toward the modiolus, and had caused the tractus spiralis foram. to disappear; yet here, also, it had a sharply defined boundary, and was composed of concentric layers, touching the bone. (Fig. 6, *b*.)

But in the modiolus, *i. e.*, beyond the tumor, the bone tissue behaved differently, appearing composed of uncommonly thin trabeculæ between which were seen numerous blood-vessels and connective tissue. The latter was moderately rich in nuclei, and its intercellular substance was partly of a slightly fibrous, and partly of a more homogeneous nature. This newly formed connective tissue filled all the canaliculi through which, in the normal state, the nerves pass, up to the apices, becoming richer in nuclei and more distinctly fibrillous. The form of the modiolus, or of the lamina spiralis, was not altered at any point. The dilatation, tortuosity and excessiveness of the blood-vessels was very marked in the periosteum as well as within the bone; and although the vessels of the cochlea are usually very tortuous, they

were here so much more so, that numerous coils could be seen with the naked eye on the outside of the modiolus. In their vicinity much brownish pigment was found, which was mostly deposited in multipolar cells.

Anatomical examination, as well as the negative result obtained by the chloride of gold treatment, showed that of the nervous elements not a trace remained in the whole modiolus. This entire absence of the nervous elements could best be demonstrated in the *canalis spiralis modioli*, which appeared almost entirely empty. In every section of the canal were seen the *lacunæ* which had been occupied by the spiral ganglion, but in which, now, hardly any elementary parts were contained; only a few fine *trabeculæ*, similar to those found in mucous tissue, traversed the *lacunæ* and here and there embraced a blood-vessel. The appearance of the whole was, however, rather that of a lacuna than that of a space filled with peculiar elements.

To this I hardly need add, that no nerve fibres were seen between the *lamellæ* of the *lamina spiralis ossea*; they were replaced by a delicate transparent connective tissue, moderately rich in nuclei, which, without definite boundary, extended into the upper and lower plates. These being deprived of lime, looked more like connective than bony tissue.

A report on the condition of the *ductus cochlearis*, the walls of which were intact, forms a necessary supplement to the foregoing description.

That no nerves were transmitted through the *habe-nula perforata*, was of course to be expected. It was therefore of great importance to determine which parts

of the acoustic terminal apparatus were preserved in our case, and which were not. In this we succeeded beyond our expectations, inasmuch as the elementary parts were much better preserved than we could have hoped for, considering that the specimen was not removed from the corpse till twenty-four hours after death. I look upon this as a proof that, in the future, the pathological histology of the labyrinth will yield more available results than is at present thought probable.

In the first place, I must state that the rods forming the arch around which the other elementary parts of the acoustic apparatus are grouped, were exceedingly well preserved in all the windings of the cochlea (Fig. 7, *f* and *g*). The broader epithelial arch, adjoining the above, was also unaltered on its outer side (towards the wall of the cochlea), and in an outward direction its continuous connection with the epithelium of the zona pectinata was distinctly visible (Fig. 7, *l*). The membrana reticularis, also, was well preserved, as shown in transverse sections and the position of the parts connected with it. I did not make any surface preparations. Corti's membrane appeared in the different sections, as usual, more or less retracted and distinctly striated. The inner portion of the epithelial arch was destroyed; but little weight is, however, to be attached to this, as it is not unfrequently torn off during the preparation. It is especially noteworthy, however, that the inner auditory cells which adhere to the first row of rods had changed their original form. In their place were found small round cells, with a perfectly clear, transparent body,

and a nucleus intensely stained by aniline. Some of these cells were free and densely crowded together; others were attached to the upper ends of the inner rods, and manifested themselves as the original inner upper auditory cells (*h*).

The same change was observed in the outer auditory cells. Immediately below the *membrana reticularis* lay small round cells, like those above described; the same forms were seen, less regularly, above the *membrana basilaris*, outwards from the second row of rods, confined between the rods and the sloping epithelial cells. In a section taken from the second turn, I found on the upper surface of two descending auditory cells (cells of Corti), short and long stiff hairs, *i. e.*, processes, which originally extended to Corti's membrane, and which, according to other writers, are cilia-like appendages to the upper terminal surface of these cells.*

From the above it is seen that, with the exception of the terminal nerve cells, which appeared to be atrophied, all the parts of the acoustic terminal apparatus were found in a good state of preservation.

The great development of the vessels was no less marked in the *stria vascularis* of the cochlear canal than in the *modiolus*.

Concerning the vestibule and the semicircular canals I have not much to report. The epithelium and connective tissue envelope of the sacculi and membranous canals were well preserved; large and numerous vessels were observed in the envelope. The macula and

* With regard to the terms used here, I must refer the reader to my essay on the development and structure of the labyrinth of the ear. Dresden, 1869.

the cristæ acousticæ were unaltered in form, but no nervous fibres were seen to enter into these structures.

The facial nerve was present from its angle, and entirely filled its osseous canal. In sections of the ganglion geniculi its cells could be recognized with higher magnifying powers; but they were so exceedingly small, clear, and transparent, that they required a good deal of search to be seen. In preparations hardened in Müller's fluid and subsequently stained with aniline, the cell substance around the likewise very small round nucleus was so pale that the greatest attention was necessary to distinguish it between the nervous bundles in sections of some thickness. In short, there can be no doubt that the said ganglion was very much atrophied, and I think that we can assume, with equal certainty, that a part of the cells had been entirely destroyed, since the group still present occupied only a very small space. The nerve fibres running in the canalis Fallopii, towards the periphery, belonged mostly, if not all, to the nervus petrosus sup. major.

I now return to the tumor found within the cranial cavity, the external appearance of which has already been described, for the purpose of adding the results obtained from its microscopical examination. In this connection I may mention that, with regard to its coarse anatomical nature, I have directed my investigation especially to the solution of the question: Is this tumor a neuroma or a fibrous sarcoma of the auditory nerve? This discrimination seemed to me necessary, since Virchow,* from his own experience, is inclined

* Die krankhaften Geschwuelste. Vol. iii., p. 296 and 297.

to classify similar tumors of the auditory nerve generally amongst the neuromata. The total destruction of the ganglionic cells and nervous fibres of the cochlea and vestibule, and the partial atrophy of the cells of the ganglion geniculi, did not prevent me from making a closer examination, but I endeavored to arrive at a decision in different ways, as I am of the opinion that the judgment formed has a bearing not only on this, but on many other cases recorded as neuromata.

With regard to its general structural relations, even the weaker magnifying powers showed that the tumor was everywhere composed of a network of fibre bundles, crossing each other in very different directions, whilst their finer elementary parts ran parallel to each other. At the entrance of the inner auditory meatus, almost the entire mass of fibre bundles was arranged parallel to the course of this canal, thereby raising the suspicion of a new formation of nervous fibres. The number of nuclei varied in the several bundles, as was best seen in the sections stained with aniline; at one place they appeared scant, and at another abundant; but, on the whole, they were distributed regularly in each bundle of fibres.

Generally speaking, it may be said that the peripheric portions of the tumor contained more vessels and nuclei than its central portions. A close examination of that part of the tumor lying within the petrous bone, and of which microscopic sections through its entire width are readily made, showed that the structure, at every point where it was in direct contact with the atrophied walls of the internal auditory canal, was

composed of concentrically arranged layers, with comparatively numerous vessels and nuclei. In the centre of the auditory canal the structure was more coarsely fibrous, and when examined by reflected light, its intertwined fascicles presented a distinctly lustrous appearance similar to that of a tendon (preparations in Canada balsam).

The main portion of the tumor lying within the cranial cavity presented somewhat different features. It had throughout the consistency of the softer fibromyomata of the uterus, and was of uniform structure in all its parts ; only here and there were seen a few gaping larger blood-vessels. The microscopic sections, whether they were taken from the periphery or the centre, presented everywhere the same picture of interlacing fibre-fascicles of an uncommonly uniform grain, the filaments of which could be isolated, and were frequently in connection with nuclei, placed at regular intervals. That most of the signs considered characteristic of neuromata were present here, I could not fail to observe. A more careful examination has, however, convinced me of their insignificance.

First of all, I must state that the staining produced by the action of the chloride of gold did not show any difference in the several parts of the tumor. None of the fascicles were of a darker color than the rest, and in none of the bundles were the finest filaments made particularly distinct by the solution of gold. The preparation was, on the contrary, of a uniform color throughout, with the exception of the nuclei, which were conspicuous in the basis substance. Amongst the

fibre fascicles were some that could, without a doubt, be declared as coarse connective tissue fibres, as will be demonstrated hereafter. Had the tumor contained nervous elements there would have been a difference in the appearance of the fibres when treated with gold, but none could be seen.

The result is also a negative one from an anatomical point of view. For the purpose of making a comparison, I procured embryonic nerve-fibres of sheep embryos of various ages, and treated the preparations in precisely the same manner as those taken from the tumor, devoting particular attention to the examination of the auditory nerve. This examination has enabled me to point out the following differences :—

The fibrillæ of embryonic nerves had the same thickness and appearance, even if they were arranged in bundles and examined in extensive longitudinal sections.

Most of the nuclei adhering to them were oval, some perfectly circular. On isolation, the bundles split readily into the finest fibres, on which the nuclei formed knotty swellings.

But I lay much stress on the examination of the transverse sections, which in very young embryos showed the axis cylinders when embedded in a substance of a different refracting power, as circular figures or dots, which, according to the illumination, appeared now shining, now dark in the clear field. In the tumor I found nothing of this description, but a more careful examination seemed to disprove directly their nervous character.

To begin with, the tumor contained fibre fascicles, remarkable for their peculiar rigidity. This peculiarity was less apparent under weak magnifying powers, but if very thin sections were placed under superior lenses, it was seen that they were composed of parallel fibres of comparatively great thickness (Fig. 8 *a*). Amongst these were always some which appeared especially broad, but which were not of the same thickness throughout, and on account of their rigidity could be compared only to elastic fibres. Between them lay but few very small oblong nuclei.

Other bundles had a finer striation, which was more or less distinctly visible (Fig. 8 *b* and Fig. 8 *c*), and contained a large number of nuclei, also of an oblong form. These bundles, which formed the bulk of the tumor, might more readily have been taken for nerve fibres, and have, I think, been described as such. On unravelling them, I obtained a result entirely different from that produced by the tearing up of an embryonic nerve-trunk. I obtained undulating fibres of unequal width, which were isolated with difficulty, and between which were embedded small spindle-shaped cells or only oblong or roundish nuclei (Fig. 8 *d*). Thus their faint resemblance to nerves has vanished. On tearing the trunk of a nerve we never obtain rigid fibres so unequal in breadth and direction.

A wholly different appearance was presented by transverse sections of such fascicles. If they were made exactly at right angles to the course of the fibres, the nuclei appeared more densely crowded, of a roundish shape, and were embedded in a finely granular homo-

geneous matrix. (Fig. 8 *c*.) The definite outlines of the axis cylinders were entirely wanting, the presence of which could alone justify us in calling a pathological formation a neuroma.

Lastly, there were parts in our tumor, the fibre fascicles of which, if examined with weak powers, were remarkable only for their great abundance of nuclei. But on examining thin sections of these fascicles with a Hartnack's immersion system No. 10, they were found to be composed of very small spindle-shaped cells, which were so closely aggregated that only a small quantity of slightly fibrous intercellular substance found room between them.

I therefore arrive at the conclusion that the tumor under consideration should be classed among the fibro-sarcomata.

EXPLANATION OF PLATES.

TABLE I.

Fig. 1. Sketch of the tumor (A). The tumor being slightly pushed aside on the under surface of the left hemisphere of the cerebellum (B).

C = Crura cerebelli.

D = The common trunk of the auditory and facial nerves. Natural size.

Fig. 2. A = Transverse section of the left optic nerve, taken from the immediate vicinity of the chiasm. *a* = Sheath. *b* = gray atrophic spot. *c* = Relatively preserved nerve bundles, within which numerous granular bodies are seen.

B = A coarse cord of connective tissue of the sheath, connected with the fine network (*a*) of the atrophic spot, and the nuclei contained in it (*c*).

C = Another place in the atrophic optic nerve : *a* = network ; *b* = nuclei ; *c* = a corpusculum amylaceum. B and C =

Fig. 3. Meridional section through the retina. The broad end of the figure corresponds to a point 1 mm. distant from the papilla; the other end 3 mm. farther outwards.

a = Membrana limitans and the broadened ends of the radial fibres; b and b' = layer of nervous fibres; c = ganglionic layer; d and d' = inner molecular layer; e , g , and k = granular layers; f = outer fibrous layer and outer molecular layer; i = bacillar layer; v = blood-vessel.

PLATE NO. II.

Fig. 4. a = The broad ends of the radial fibres; b = lymphatic space; c = layer of nerve fibres, transversely divided; d = inner molecular layer. Immersion system No. 10, Oc. 3.

Fig. 5. Section through the retina, transversely to the course of the larger blood-vessels. The latter surrounded by proliferating connective tissue. The letters have the same signification as in Fig. 3.

Fig. 6. Section through the inner auditory canal and the axis of the cochlea. a = the tumor entering the porus acusticus internus; at b it bulges towards the modiolus. c = dilated vessels of modiolus.

Fig. 7. Section of the acoustic terminal apparatus, from the third winding of the cochlea.

a = lower; b = upper plate of lamina spiralis ossea; c = connective tissue and blood-vessels between the plates; d = membrana basilaris; e = the epithelium of labium vestibulare; f = inner, g = outer rod; h = altered upper inner auditory cell; i = small round cells; k = membrana reticularis; l = the epithelial arch behind the outer auditory cells, which in man is very thick; m = epithelium of zona pectinata.

Fig. 8. Fibre fascicles from the tumor of the auditory nerve. Hartnack's immersion system No. 10. a , b , and c = thin sections; d = unravelled fascicle; e = transversely divided fibre fascicle.

DISEASES OF THE MASTOID PROCESS; THEIR DIAGNOSIS, PATHOLOGY, AND TREATMENT.

By ALBERT H. BUCK, M.D.,

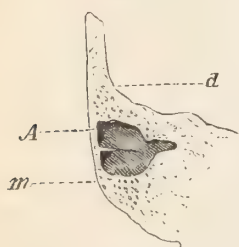
OF NEW YORK.

THE bony prominence, lying behind the ear and known as the mastoid process of the temporal bone, may be the seat of various morbid processes. It is true that these are usually secondary to affections of the meatus or tympanic cavity, where the disease originates and from which it is propagated either to the fibrous covering of the bone or to the peculiar cells which fill its interior. This propagation is not the rule however. In the far larger proportion of cases the inflammation is confined to the locality where it first made its appearance, and only in rarer cases the mastoid body is invaded. These are the cases in which we meet those groups of clinical phenomena which are usually known as mastoid diseases. As a rule we are not justified in giving a new name to morbid processes which are simply extensions of the same vital changes to different portions of the same tissue. In this instance, however, the ultimate pathological results give rise to special trains of symptoms which call for peculiar treatment, and therefore warrant us in regarding the diseases themselves as essentially separate.

Two important facts will attract our attention in re-

viewing the literature of this subject. It will be seen that in a large majority of instances *the disease was not appreciated* and that the *mortality has been very large*. Let us inquire into the causes of these two facts. The rarity of the affection cannot be urged by practitioners as a reason for their ignorance. I have good grounds for believing that such cases occur with tolerable frequency in ordinary practice: they certainly form a fair percentage of the cases which come under treatment at our infirmaries. Much of the fault must be laid to our ordinary text-books on surgery, even the most recent, for they either omit the subject entirely or dismiss it by a brief allusion to caries of the mastoid body as a disease of rare occurrence. We find

FIG. 1.



A vertical transverse section through mastoid portion of an infantile temporal bone.

d = dura mater.

A = antrum.

m = rudimentary mastoid process. (Natural size.)

some attention given to the subject in our text-books on otology and in monographs, but much still remains buried in obscurity.

The following article will aim to show the course of the diseases through their various stages. A sufficient number of cases will illustrate the points brought forward, and certain features will be noticed that will enable the ordinary practitioner to recognize the gravity of the

affection at an early stage.

At birth the mastoid process consists of a small, flattened tuberosity, containing but one cell of considerable size—the antrum. (See Fig. 1.) At puberty there is a distinct prominence, conical in shape, whose apex

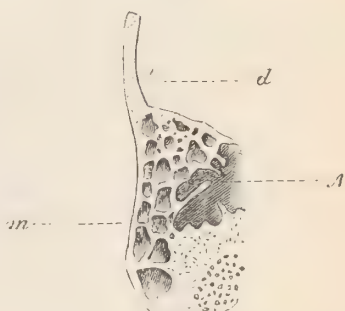
points downwards, and whose length, in some instances, may measure an inch and a quarter. (Figs. 3 and 5.) The substance of this bony prominence is formed of a number of small cavities, or cells, varying very greatly in size and shape. These cells communicate with one another, and are lined with an extension of the mucous membrane of the tympanum. Their mode of distribution and size vary so much in different individuals, that it is scarcely possible to give a description which will be true in even a majority of instances. The accompanying figures illustrate some of the most striking forms. In thickness the outer lamella of bone varies very materially in different individuals; at times being almost as thin as ordinary

writing paper. At the posterior end of the tympanic cavity is the entrance to the mastoid vestibule, if I may so call it. This entrance, which is sometimes double, is rather narrow, and lies at a much higher level than the floor of the tympanum.

In the adult the vestibule, or antrum (horizontal portion of the mastoid cells, Toynbee) is placed much nearer the dura mater and the lateral sinus than the outer surface of the bone.

It is an irregularly-shaped cavity, oblong in its antero-posterior diameter, and having honey-combed walls

FIG. 2.

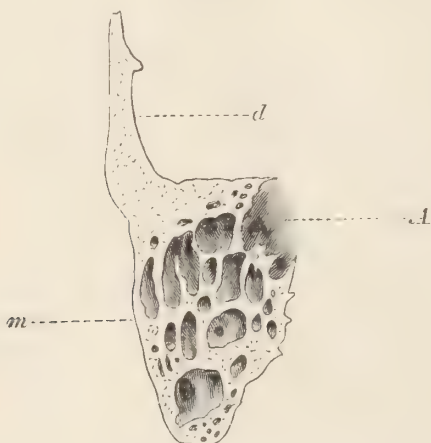


Mastoid process of a child (æt. circa

5). Same section and lettering as in Fig. 1. (Natural size.)

with numerous ridges and intervening depressions, which lead to the surrounding cells. In adults the vestibule is just large enough to admit a small-sized pea, or sometimes a still larger body.

FIG. 3.



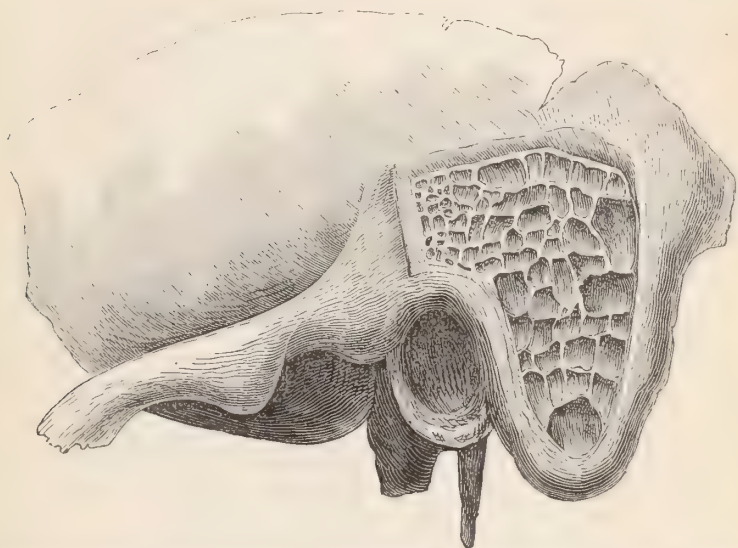
Mastoid process at puberty.
Same section and lettering as in Fig. 1. (Natural size.)

As a rule the cells are not confined merely to the mastoid process, but extend forwards over the external auditory canal, and upwards towards the parietal bone, to a still higher level than the canal. (Fig. 4.) In fact we may regard the entire mastoid system as a collection of bony cells, each one of which is lined with mucous membrane, and communicates with its neighbor by a narrow passage. They all have their final outlet into the middle ear through the antrum.

In no other part of the body do we find a mucous cavity so ill adapted to withstand the action of morbid processes.

In this respect the ethmoid, sphenoid, maxillary and frontal cells, which are the only similar structures, are much more favored. The reasons of this are apparent. The nasal cavity, into which they all open, has very

FIG. 4



Mastoid process. External portion chiseled away to show how far the cells extend.

broad outlets and is rarely the seat of grave inflammation. The ethmoid and frontal cells have a further advantage: their outlets are at the most dependent portions of the cavities, so that gravity facilitates very materially the discharge of any accumulation. This is not true, however, of the antrum maxillare and sphenoid cavity, though in their case the danger of the extension of an inflammation to the brain is materially lessened by the circumstance that the point of least resistance is on the side toward the nostril, and not toward the brain. In the mastoid cells the reverse is true: their natural

outlets are so small that under inflammatory action they may very readily become closed, and before the imprisoned pus can force its way through the outer table of the bone, the periosteum and thick integuments, there will be great danger of its involving one or both of the adjacent structures—the brain and lateral sinus. The danger is still further enhanced by the passage of one or more small veins through the upper portion of the process, which form a medium of communication between the lateral sinus or its branch, the superior petrosal sinus, and the veins on the outside of the cranium (Henle).

FIG. 5.

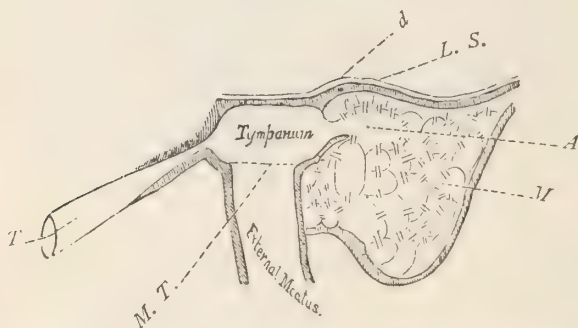


Diagram showing the relations of the dura mater, lateral sinus, external meatus and tympanum to the mastoid cells.

T = Eustachian tube.	M = mastoid process.
M. T = membrana tympani.	L. S. = location of the lateral sinus.
d = dura mater.	A. = antrum.

Disease of the mastoid process may usually be recognized under the following forms:—

1. Inflammation of the external periosteum.
2. Simple congestion of the mucous membrane.
3. Congestion and filling up of the cells with a reddish, pulpy material.

4. Chronic subacute inflammation of the mucous membrane with sclerosis or hyperostosis.
5. Caries, with accumulation of pus, within the mastoid process.

The second, third, and fifth forms are simply the three different stages of an acute inflammation; yet for practical purposes it is better to regard them as separate varieties.

I. Inflammation of the External Periosteum.

This occurs as a concomitant symptom or phase of an acute inflammation of the external auditory canal. The periosteum of the mastoid process is a direct continuation of that which lines the meatus externus; hence it not infrequently happens that an inflammation of the latter extends to the mastoid body. As it is characterized by tenderness, pain, and swelling of the parts, it may easily mislead one into the belief that the mastoid cells themselves are the seat of the trouble.

The following case is a good illustration of this first form:—

CASE I. (New York Eye and Ear Infirmary).—Sarah Golden, æt. 18, October 16, 1872. No ear trouble until about a week ago, when she began to suffer from a roaring in the left ear, followed shortly by pain, which gradually increased in severity, and extended to the mastoid region. No discharge. Watch heard at a distance of two inches. Outer orifice of the meatus almost closed by the congested and swollen condition of the parts. Beyond the constriction a hard mass of impacted cerumen was seen. The integuments covering the mastoid process were red, swollen, and tender to the touch. Patient evidently in great suffering. The impacted mass was broken down piecemeal, by a probe, and removed with a delicate pair of bent forceps. The

deeper portion of the mass was found to rest against the *membrana tympani*.

All the unpleasant symptoms rapidly disappeared after the removal of the mass.

In these cases the treatment consists in allaying the inflammation of the meatus, after which the tenderness and pain behind the ear soon disappear of themselves. Sometimes the inflammation of the periosteum results in the formation of an abscess in the subcutaneous cellular tissue of the mastoid region without involving the subjacent bone to any appreciable extent. In such cases the indication is to afford a free outlet to the pus by a suitable incision. The following case illustrates this point :—

CASE II. (New York Eye and Ear Infirmary).—March 27, 1872. Benjamin Curtin, æt. 24, a robust, powerfully-built man, was taken with a severe earache and tinnitus nine days ago. No discharge until two days ago. Removal of pus from the meatus brought into view a small mass of granulations, springing from the lower wall, about at the junction of the cartilaginous with the osseous portion. By the aid of a curved probe it was ascertained that these granulations concealed the entrance to a sinus, which led downwards and backwards a distance of three-quarters of an inch. No exposed bone could be felt. The integuments over the mastoid process were red, swollen, and tender to the touch. *Membrana tympani* red and swollen, but not perforated.

Valsalva's experiment caused pus to escape from the opening in the lower wall of the meatus. *Membrana tympani* punctured, and pus driven out through the incision by means of Politzer's inflation. Leeches also applied to mastoid region. April 3. Swelling behind the ear is more prominent, and extends much lower downwards. A free incision gave escape to about two ounces of healthy pus. A careful exploration revealed the fact that the bone was still covered at all points by periosteum. From this time the recovery was rapid.

As a point of interest in differential diagnosis it will be well to mention here that a small gland is sometimes found lying directly upon the mastoid process. In certain affections of the middle ear and external auditory canal, this gland becomes painful, swollen, and tender to the touch, and may lead the surgeon to suspect mastoid disease. A few applications of the tincture of iodine usually suffice to dispel the pain and swelling.

II. Simple Congestion of the Mucous Membrane.

The second form may be observed, in a very slight degree, in many cases of acute inflammation of the middle ear. In these cases the patients direct the surgeon's attention to the deeper parts of the ear, and rarely to the mastoid region. In a few cases, however, the trouble is referred chiefly to the mastoid process. These are the cases which may be classified under the head of simple congestion of the mastoid mucous membrane. The following examples will illustrate the prominent clinical features of this form of disease:—

CASE III.—Mrs., æt. circa 30, of excellent health, after exposure during house-cleaning on the 1st of May, 1872, began to suffer from sore throat, slight deafness, and pain in the right ear. The pain soon extended to the parts behind the ear, and gradually increased in severity, robbing her of her sleep. On the 6th of May I saw her for the first time, and found the ear in the following condition:—The external auditory canal normal; the membrana tympani red and swollen, though entire; the Eustachian tube closed to Politzer; very marked tenderness on pressure, and some redness of the skin over the mastoid process. Upper portion of pharynx moderately congested. Watch heard when pressed against the ear. Four leeches applied over the mastoid process gave great relief. May 9th. Pain and tenderness

entirely gone. A solution of nitrate of silver (3j— $\overline{\text{z}}$ j aquæ) applied to the still swollen membrana tympani. May 13. No return of the pain. Swelling of the membrana tympani diminishing. Watch heard at a distance of half an inch. She subsequently had no return of the pain in that ear, and the improvement in hearing was steady and marked.

On the 8th of the following November I was consulted again for a very similar attack in the left ear. The history given was that about the 1st of November she was attacked with a severe pain behind the ear, accompanied by tenderness on pressure, and a little swelling. The application of six leeches to the affected part relieved these symptoms entirely, but on the previous night the pain returned with considerable severity. On examination I found the left membrana tympani sunken, but not congested. Watch heard at a distance of three feet. There was tenderness over the mastoid process, and some œdematous swelling of the integuments. Six leeches applied behind the left ear afforded entire relief. Since this time there has been no recurrence of the trouble.

CASE IV.—(N. Y. Eye and Ear Infirmary.)—Mary A. Hanley, æt. 32, in robust health, was attacked with an influenza on the 9th of November, 1872. She had more or less fever, and a constant catarrh of the eyes and nose. On the 12th, the right ear became involved, the symptoms being moderate deafness, roaring and some pain. Watch heard at a distance of 6 inches. External auditory canal healthy. Membrana tympani dull, opaque and rather flatter than normal. The air during inflation entered the middle ear with a dry sound. Four leeches applied in front of the ear. Nov. 14. The leeches afforded only partial relief. Membrana tympani œdematous in appearance and somewhat convex outwardly. Nov. 15. Passed a bad night. The pain is again severe, and is referred by the patient to the entire side of the head. Tenderness on pressure over the mastoid process. The posterior wall of the external auditory canal has also become tender upon pressure. A free vertical incision through the posterior half of the membrane was followed by an oozing of bloody serum from the wound. By inflation of the middle ear through the Eustachian catheter the serum was made to escape in such quantity that it ran down over her

cheek. Nov. 16. Comparatively free from pain last night. The watery discharge continued through the night, as shown by the stains on the pillow. The tenderness has disappeared, and patient feels quite well again. No subsequent return of the pain.

If the pain should not yield to moderately active local blood-letting (leeching), an incision may be made over the mastoid process, down to and through the periosteum. If both of these means fail to relieve the patient's suffering, and especially if after the temporary relief, which leeches or an incision are pretty sure to afford, the pain returns with even renewed severity and extends backwards toward the occiput and upwards toward the vertex, we may then draw the inference that the disease has already passed into the third, or even the fifth form. As a rule, however, the measures here recommended prove sufficient to check the further progress of the inflammation.

IV. Chronic subacute inflammation of the mucous membrane with sclerosis, or hyperostosis.

While this form constitutes a distinct pathological condition, we are not yet in possession of sufficient clinical facts to guide us to a positive diagnosis.

Sclerosis or hyperostosis of the mastoid process, is associated with either chronic catarrhal, or chronic purulent inflammation of the middle ear. Its progress is so insidious and so rarely accompanied by any marked symptoms that it is only at the post-mortem examination, or when called upon to trephine the bone, that we discover the existence of this condition. As the very delicate membrane, which lines the mastoid cells,

serves the double function of mucous membrane, and periosteum to the intercellular bony septa, it will be readily understood how a chronic congestion of the membrane may result on the one hand in thickening of its substance, and on the other in hypertrophy of the bone which it nourishes. In place then of air-containing cavities, separated by thin septa of bone, we find a tolerably dense bony mass, whose substance is studded throughout with small collections of slightly vascular connective tissue. (Fig 6.) Where this condition of things is the result of a chronic purulent inflammation of the middle ear we shall often find that the antrum is the receptacle for a mass of cheesy material, produced by a retrograde metamorphosis of pus, epithelial cells and mucus. Such masses have sometimes been found in the cavity of the tympanum, where the perforation in the membrane was small, or in one of the upper segments. This material probably owes its existence to the fact that the fluid elements of the discharge find an escape through the small outlet, while the solid portions remain behind and gradually accumulate until they form a solid mass, which entirely fills the antrum. From the frequency with which such masses are found in fatal cases of caries of the mastoid process, I think we are justified in believing that their presence in the antrum is not unattended with danger to life. The carious process in these cases appears to originate in the antrum, and its further progress to be confined chiefly to the region lying between that cavity and the fossa sigmoidea. This may be explained by supposing that the pus, prevented by the cheesy mass from escaping through its

natural outlet, sought an escape through the bone in the direction of least resistance, viz., toward the lateral sinus, or the dura mater.

I know of no series of symptoms which will enable us to recognise this form of disease with certainty, though sometimes certain symptoms, like those narrated in case No. 5, should lead us to suspect its existence.

Dr. Hermann Knapp of this city gave me an instance of a case of this kind which came under his observation. Suspecting cheesy matter in the antrum, he introduced a curved probe (as first proposed by Toynbee, *Med. Times and Gazette*, March 16, 1861) and succeeded in dislodging and removing quite a large accumulation from that cavity. I proposed to make a similar attempt in the following case, in which sclerosis of the mastoid cells with cheesy accumulation in the antrum was suspected. The patient however did not consent.

CASE V.—Mr. C., æt. 24, somewhat anaemic, but otherwise in good health, consulted me in March, 1872, for an otorrhœa of fifteen years standing. It had established itself as a sequela of scarlet fever and was accompanied by tinnitus and a dull steady pain, referred to the deeper parts of the ear. Various methods of treatment had been pursued, but the discharge had never materially diminished. An inspection of the ear showed the membrana tympani to have been entirely destroyed, the handle of the hammer resting against the promontory, the mucous membrane pale and very fibrous in appearance, and the posterior upper portion of the tympanic cavity filled with a small mass of granulations which seemed to grow from the entrance to the antrum. There was no tenderness over the mastoid process. The watch could be heard at a distance of 7 inches. A few applications of chromic acid were made, and the granulations shrank entirely out of sight behind the projecting angle of bone.

The subsequent treatment consisted in introducing a probe armed

with cotton, thoroughly cleansing and drying all the parts within reach, and then applying nitrate of silver in solution (the strength being gradually increased from twenty grains to a drachm to the ounce of water). At the expiration of two weeks the discharge was just as abundant as at the first. On the 29th of March, I substituted powdered alum for the silver solution, blowing it in with a suitable tube. The quantity used was just sufficient to form a thin layer over the exposed mucous membrane. On the 30th the patient reported that there had been almost no discharge since the last application. The alum was accordingly applied a second time, after all the remains of the first charge had been removed. This second application was followed in the course of an hour by dizziness, nausea and vomiting, and a throbbing sensation in the ear, without tinnitus. Objects appeared blurred before his eyes. Two hours afterwards he had a second similar attack, which compelled him to take to his bed. The dizziness and nausea continued then for nearly 48 hours, when the discharge reappeared, and he was again able to walk about.

In view of the long continuance of the discharge, of the constant, dull, deep-seated pain, of the presence of granulations which seemed to spring from the entrance to the antrum, and from the throbbing sensation which ensued, when that entrance became closed—as it doubtless did when the alum was applied—it appeared to me probable that the case was one of chronic purulent inflammation of the antrum, associated perhaps with a cheesy accumulation and sclerosis of the mastoid cells; and in this opinion I was confirmed by Dr. Hermann Knapp, who afterward saw the patient with me in consultation. Case No. 16 shows us that we may meet this form of disease in persons as young as Mr. C. —.*

* Dr. J. L. Vandervoort of this city has given me the following details of a case which perhaps belongs more properly to this than to the first form :—A lady, æt.

III. *Congestion and filling up the of cells with a reddish, pulpy material.*

V. *Caries with accumulation of pus within the mastoid process.*

In very many cases the clinical features of these two forms coincide so closely that it is exceedingly difficult, if not impossible, to distinguish between them. It is only in certain well-marked cases, that we can say: in this case the disease has gone on to the formation of pus in the mastoid cells. The important point, however, is to diagnosticate whether the disease has reached either of these two stages, for if left to itself the third form will soon pass into the fifth and endanger the patient's life.

The following cases will illustrate these two forms of disease.

CASE VI. (reported by Dr. Flaiz, in the *Archiv für Ohrenheilkunde*, vol. 2). The patient, a man 46 years of age, and previously in good health, was exposed to severe weather during the summer of 1864. Pain in both ears with deafness ensued. His physician sent him to the warm baths at Aargau, but at the end of three weeks he returned having grown worse rather than better. On the 17th of September, 1864, Dr. Flaiz was called to see him. On examination he found the mastoid process of the left side very tender on pressure. The calibre of the external auditory canal was diminished, and filled with pus. The membrana tympani was invisible. Inflation of the middle ear revealed the existence of a perforation in the membrane. Ordered a cathartic and leeches to the left ear.

54, has an exostosis projecting from the central portion of the mastoid process. It is about the size of a nutmeg, hemispherical in shape, smooth and painless, and has existed for over 30 years. When 14 years old she had scarlet fever which left her with an otorrhœa that ceased only twelve months ago. The growth of the tumor was quite slow. It has remained at its present size for many years.

September 20th. No relief yet. Leeches to be repeated. 21st. A free incision over the mastoid process. This relieved the pain, and the wound was allowed to heal.

October 15th. Pain has returned. Fluctuating swelling over mastoid process. Incision and evacuation of half an ounce of pus. No roughness of bone detected. Pain relieved. Wound again allowed to heal. By degrees the pain returned with its former severity, and was referred chiefly to the left occipital and parietal region. *October 26th.* Patient delirious. Mastoid process perforated with a drill, no pus found. *October 27th.* Free discharge from the wound. From this time there was a steady amelioration in all the symptoms, and at the end of four weeks the patient was able to resume his work.

In this case we are not informed what the condition of the mastoid cells actually was. It should be remembered, however, that when an operation of this kind is performed, the facilities for making a minute examination into the condition of the bone are not usually at hand; the most we can do is to distinguish the red of the congested mucous membrane, the yellow of the pus, or the whitish hue of the sclerosed bone.

CASE VII. (N. Y. Eye and Ear Infirmary.)—Richard Murphy, æt. 11, phthisical in appearance, contracted about the 4th of September, 1872, a pain in the left ear, in consequence of exposure to cold. Two days later a discharge appeared, and from that time to this (September 11th) he has suffered from severe pain in the affected ear. To day the discharge ceased. Patient appears to be in great suffering. Pulse 108 and feeble. Tenderness and œdema over the left mastoid process. The external meatus closed by the swelling of its walls. Valsalva's experiment caused dizziness, and retching. The patient being under the influence of ether, an incision was made through the integuments of the mastoid process. The surface of the bone was found to be normal in appearance and consistency. The outer shell of bone was then perforated with a conical drill, which exposed to view the mastoid

cells at a depth of less than two lines. These were found to be highly congested, and the thin bony septa readily broke down under the pressure of the steel director. No pus was found. A small tent was introduced into the wound, and a poultice applied to the parts. Milk and beef-tea diet. Decubitus. September 12th. Pain is gone, but he is unable to keep anything on his stomach. The discharge from the meatus has returned. Some erysipelatous swelling about the wound. Ordered lime water p. r. n.

Sept. 13.—Food retained. General condition decidedly better. Free discharge from the meatus. Wound granulating. No return of pain. Ord. simple dressing to wound, tent to be left out and poultices omitted; also to take quin. sulph. gr. i. t. i. d. and solid food. *Sept. 14.* Erysipelatous blush is fading away. *Sept. 16.* Continued improvement. Is now able to leave the house. *Sept. 18.* A free discharge both from the meatus and from the wound. Ord. iron and cinchona to be substituted for the quinine. *Sept. 21.* Entire freedom from pain since the operation. His general condition, however, is not so good as when he last visited me three days since. Night-sweats have set in.

Since the last note I have not heard from the boy, and am inclined to think, judging from his low condition, that he did not survive many weeks. The operation certainly gave great relief, but the subsequent copious discharge of purulent matter was too great a strain for a system burdened with phthisis, and he probably succumbed under both.

CASE VIII.—Dr. A. P. W., of Chester, S. C., æt. 56, of a strong constitution, consulted me, Oct. 12, 1872, for a painful affection of the mastoid process. He gave the following history:—In 1835 he contracted an acute inflammation of the left middle ear from the bursting of a gun barrel. The severe symptoms soon passed off, but the purulent discharge continued for some time after. Since that time, however, the ear has not troubled him in any way, except that there has

been a moderate degree of deafness and some tinnitus. The perforation in the membrane has always persisted. About the middle of last July he noticed a slight serous discharge from the left ear, and felt a little pain in it. The pain became gradually more severe and was associated with headache and fever. The doctor bled himself to the extent of about sixteen ounces ; six hours later he took from the arm an additional quantity of about eight ounces. A profuse suppuration from the ear soon took place and the pain then became tolerable. For a month no marked change occurred in the condition of the ear. The discharge continued, but at times it would almost stop. On the 23d of August he had a rigor, which was followed by a return of all the acute symptoms. The pain was referred to the base of the brain, the mastoid process and the articulation of the jaw. That night the pain, according to his own words, was frightful. Bleeding to the amount of twelve or fifteen ounces afforded some relief, and the discharge again became abundant. For a week the pain remained bearable. On the 31st of August he had another rigor, followed by intense pain, referred to the mastoid process, and thence backward toward the occiput and occipito-vertebral articulation ; in fact the whole side of the head was painful. There was tenderness over the mastoid process and the auricle was pushed somewhat out from the head. On the 2d of September, Dr. Darby, Professor of Surgery in the University of Columbia, S. C., and Dr. Robinson, of Winsboro', were telegraphed for, but by the time they arrived the discharge was re-established, and the pain had moderated. The mastoid region, however, was still swollen and quite tender on pressure. On the 18th of September, no improvement having taken place in his condition, the doctor started for New York in the hope of obtaining relief there. The sea voyage from Charleston benefited him very decidedly. The severe symptoms abated, and for some time after reaching this city he enjoyed, at least during the day, comparative comfort ; toward night, however, the old trouble returned with greater or less severity. During the few days preceding his visit to me he suffered acutely from pain in the ear.

On examination the meatus was found to be normal, the membrana tympani perforated anteriorly, the Eustachian tube freely open, and only a trace of pus in the middle ear. Mastoid region œdematous and tender on pressure. The tenderness also extends back toward

the occiput. General condition fair. Pulse a little over 90. No heat of skin. At a consultation with Professor James R. Wood and Dr. Hermann Knapp, it was deemed best to perforate the mastoid process. At the patient's own request the operation was performed without ether. The appearance of the bone, after the periosteum had been lifted aside, was entirely normal. The drill was applied on a level with the upper wall of the meatus, and made to penetrate to a depth of three-fifths of an inch without encountering mastoid cells. At this depth, however, a tolerably firm pad of connective tissue was felt. The supposition at the time was, that this mass filled the antrum, but on subsequent inspection I became persuaded that, owing to the thickness of the swollen integuments, and the recumbent position of the patient, I had erred somewhat in the direction which I gave to the drill, pointing it too far backwards. The pad of connective tissue was undoubtedly the outer wall of the lateral sinus.

October 13th.—Passed a pretty comfortable night. Pain much easier than before the operation. Ord. quinine gr. ij. t. i. d.

October 14th.—Pain again severe. Consultation with Drs. Robert F. Weir (Professor Wood out of town) and Hermann Knapp. A second perforation was made, this time nearer to the meatus and on a lower level than the first. Mastoid cells congested, but no pus present. Tent inserted; poultices. Oct. 15. Slight improvement. Appetite rather poor. Ord. tinct. ferri chlor. gtt. X with each dose of quinine. Oct. 16. Appetite better. Temperature 97°. Pain diminishing. Ord. carbolic acid dressings to wound, from which there is a free discharge.

October 17th.—Marked improvement in every respect. Poultices to be stopped.

October 23d.—Tenderness over mastoid process almost gone.

November 14th.—Feels quite well again. There is no discharge from the meatus, and the wound behind the ear has healed except at two points, corresponding to the two sinuses which lead to the perforations in the bone. To return to South Carolina.

A few weeks later I heard from the doctor that there had been no return of the pain, and that his general health was quite good again.

CASE IX. (New York Eye and Ear Infirmary.)—Wm. B. Hillison, act. 45, janitor, previously in good health. In August, 1872, he over-

heated himself, and then sat in a draught of cool air. A few hours later, he experienced severe shooting pains in the right ear, and a throbbing sensation in the mastoid region. The pain continued, with varying severity, for ten days. At the end of this time a discharge appeared, and was soon followed by relief from pain. Early in November the discharge ceased, and the pain again became severe. This time it was referred chiefly to the region behind the ear, and was accompanied by some tenderness and swelling of the parts. The swelling gradually increased, and on December 14th he reluctantly decided to seek medical advice. His physician, Dr. Chas. E. Laight, found the meatus swollen, and the mastoid region the seat of a pretty large swelling. A free incision liberated about an ounce of healthy pus. No denuded bone detected. Dec. 15. Pain relieved. A profuse sweat to-day. Dec. 16. Mastoid region again moderately painful. Wound healing by adhesion. Occasional pain in the right chest. Dec. 18. To-day I saw the patient for the first time, in consultation with Dr. Laight. The pain again severe. The countenance pale. Pulse 108, and feeble. Holds his head as if suffering from a stiff neck. The skin and subjacent tissues over lower portion of mastoid process, and extending at least two inches below it, are soldered by inflammation into a single, flattened, hard mass, red on the surface. Tenderness on pressure, extending up toward squamous portion of temporal bone. Meatus very much swollen, and filled with fetid pus. A small mass of granulations on posterior superior wall of meatus, just beyond the junction of the cartilaginous with the osseous portion. From this point a sinus leads to bare bone, as ascertained by probe. Deeper parts not recognizable. Perforation of the bone advised, and patient recommended to enter the New York Eye and Ear Infirmary. The operation was performed the same afternoon by Dr. Laight. The perforation was made with a drill, which was applied at a point half an inch behind the meatus, a little below the level of the upper wall, and was directed inwards, decidedly forwards, and a little upwards. The instrument first encountered cell-structure at a depth of three-fifths of an inch. No pus. Ordered decubitus, poultices, generous diet, iron and quinine, and sherry wine, $\frac{3}{4}$ vj. daily.

Dec. 19. Almost entire relief from pain. Pulse 90, and stronger than yesterday. Meatus still swollen. Takes food well. C. T.

Dec. 20. Free discharge from the wound and from the meatus. Steady improvement. The wound and the meatus both to be syringed frequently with a weak solution of carbolic acid.

Jan. 18. The wound has entirely healed except at one point, where a small sinus leads to the perforation in the bone. The sinus in the meatus has also closed. Since the 8th of January there has been no discharge from the meatus. A small perforation still present in the membrana tympani. General condition greatly improved. No return of pain since the operation. Jan. 29. Patient is to-day discharged cured.

CASE X. (N. Y. Eye and Ear Infirmary.)—Mrs. Kate Ryan, æt. 36, with syphilitic destruction of the bones of the nose, but otherwise in good health, consulted me January 15th, 1873, for a painful affection of the right ear. She stated that a week previously she was attacked during the night with a severe pain and roaring in the ear. She had always been hard of hearing in that ear, but could not recollect ever to have had a discharge from it. In the course of twenty-four hours she obtained some relief by the sudden giving way of something in the ear and the appearance of a discharge at the outer orifice. Soon, however, the pain returned and gradually became almost intolerable. It extended over the entire side of the head and was accompanied by soreness in front of and behind the ear. No head symptoms.

On examination I found the external auditory canal closed by an œdematous swelling of its walls. Membrana tympani perforated but invisible. Tenderness on pressure over mastoid region; moderate œdema. Tongue coated. Appetite poor. Pulse 90 and of fair strength. No appreciable heat of skin. Incision of the mastoid integuments.

January 16. No relief from the incision. Pulse 104 and feeble. She is evidently in much suffering. Consultation with Dr. Robert F. Weir. Perforation of the mastoid process advised. As the patient preferred to bear the pain, the operation was performed without anæsthesia. The bone was perforated with the larger of the two drills (Fig. 7) to a depth of half an inch, without encountering pus. The cells were few in number, and separated by strong septa. The outer surface of the bone appeared to be perfectly normal. Treatment:—introduction of a tent into the opening in the bone, poultices every four hours, iron and

quinine, and moderate stimulation. January 17. Decidedly better in every respect. Pain moderate. Pulse 88. Takes nourishment well. The meatus and the wound to be syringed every four hours with a warm, weak solution of carbolic acid.

January 22. Continued improvement. Wound granulating. Occasional shooting pains. C. T.

January 29. Entire freedom from pain in the right ear. Wound rapidly filling up with healthy granulations. Almost no discharge from the meatus. Three days ago, without any apparent cause, the left ear became acutely inflamed. Incision of membrana tympani afforded an outlet to the pus. Relief from the pain. February 8. Steady improvement. Left ear free from pain.

February 13. No discharge from the right ear since the 10th. A thin cicatricial depression indicates the location of the former perforation in the membrana tympani. Outer wound entirely healed except at one small spot which is still covered by a scab.

CASE XI. (Reported by Von Troeltsch in Virchow's Archives. Vol. XXI., p. 296.)—A girl, æt. 16, while in good health, was attacked with scarlet fever. On the second day after the appearance of the eruption she began to suffer pain in both ears. The pain increased until the fifth day, when a discharge appeared. Subsequent decrease of pain, but at no time entire freedom from it. Constant discharge. When first seen (March 24, 1858) the patient complained of pain in and behind both ears. There was no fever. Tenderness on pressure over both mastoid processes. On the right side, redness and a diffuse swelling behind the ear. Meatus swollen. Membrana tympani perforated. Watch heard only when pressed against the ear. Ordered injections of warm water into both ears four times daily.

March 30. Swelling behind the right ear increased in size. Pain severe. A free incision over mastoid process gave temporary relief.

April 1. Pain again severe.

April 3. A small opening found in the bone. This was enlarged by using moderate force with a buttoned probe. No appearance of pus until a few hours later.

April 4. Pain entirely gone. General condition much improved. By syringing a communication was found to exist between the external fistulous opening and the cavity of the meatus. About the middle of

June the discharge ceased on the right side. External wound nearly closed.

A year and a half later she died of phthisis pulmonalis. At the post-mortem examination the cells of the right mastoid process were found to be very small and in part filled with a semi-gelatinous material.

CASE XII.—April 8, 1871, I was called to see Mrs. Peter Green (colored), æt. 47, and of strong constitution. The story was that on the preceding Christmas she had been attacked with severe pain in the right ear, followed soon after by a purulent discharge. Eight days previously, the discharge having almost ceased, she had again suffered from a severe earache, sleeplessness, occasional vomiting and at times incoherence of speech. At the time of my visit she appeared to be in great suffering. Pulse 104 and rather feeble. No heat of skin. Pus escapes through the Eustachian tube into the pharynx. Marked tenderness over the mastoid process. The external auditory canal closed by the swelling of its walls. A free incision over the mastoid process and warm fomentations. April 9.—Last night, soon after the operation, the discharge re-appeared.

April 18. Comparative freedom from pain since the last note. To-day I discovered a mass of granulations springing from the upper and posterior wall of the meatus, a little beyond the junction of the cartilaginous with the osseous portion. May 25. Occasional attacks of pain. June 5th. Another severe attack of pain last night. Motion of the jaws painful. Mastoid process tender on pressure. Ordered two leeches to the part. June 6. Some relief from the leeches. June 15. Since the last note the pain has been steadily growing worse. Leeches have been applied from time to time, but with only temporary relief. To-day there has been some nausea after meals. June 16. A sinus discovered leading from the mass of granulations mentioned above to the mastoid cells. Consultation with Dr. Robert F. Weir. Perforation of the mastoid process advised. The patient being under the influence of ether, an incision was made exposing to view the surface of the right mastoid process. The lower part of the process appeared to be softer than natural. The bone was perforated with a small drill, and the opening afterwards enlarged by means of a small gouge. No pus found. Mastoid cells congested. Two probes intro-

duced into the mastoid process, the one through the sinus, the other through the newly made opening, were found to meet.

From this time there was a rapid improvement in all the symptoms. Her general health, which had suffered materially by the prolonged sickness, soon regained its usual standard. On the 27th of July I was unable to find any trace of the fistulous opening in the meatus, and the discharge had entirely ceased. No return of the pain at any time.

Nos. 6, 7, 8, 9 and 10 afford good illustrations of the third form of mastoid disease. Nos. 11 and 12, however, represent intermediate forms between the third and fifth. Von Troeltsch's (No. 11) appears to be the only case on record in which an opportunity was offered of making a post-mortem examination of the mastoid cells after recovery had taken place. Case No. 12 confirms strongly the view that the third form, when left to itself, passes directly into the fifth. The limited caries in that portion of the mastoid cells, which lies nearest to the external auditory canal, afforded too small and too remote an outlet for the gorged cells of the remaining portion; hence the relief was unappreciable. In the following case, however, death seems to have occurred directly from an extension of the inflammation to the lateral sinus, before any appreciable amount of pus had formed in the mastoid cells. As a rule the mastoid cells will be found to be filled with pus in the cases that terminate fatally.

CASE XIII.—(Reported by Dr. Stokes in the *British Medical Journal*, Feb. 12, 1870.)—A fisherman, æt. 49, of powerful build and temperate habits, was admitted to the Meath Hospital, Jan. 12th, 1870. His history was that on the first day of the year he caught cold and began to suffer from headache. This finally became so severe that

he was obliged to stop work, and seek for relief at the hospital. By questioning him it was ascertained that whenever he caught cold he was subject to a fetid discharge from the right ear.

At the end of 24 hours the head symptoms became more pronounced. Low delirium. Fetid discharge from the ear. Profuse perspirations on this and the following days. On the 17th a sudden and extreme œdema of both eyelids. 20th. Constant delirium. Involuntary evacuation of urine. 22nd. Slight puffiness over the right mastoid process. Integuments incised, but no pus found. Death occurred on the 25th. Up to the last, but very little febrile disturbance.

At the post-mortem examination purulent basilar meningitis found ; also superficial softening of antero-inferior portion of the right side of the cerebellum. Lungs free from purulent deposits. Membrana tympani destroyed. Mucous membrane of middle ear pulpy, vascular and bathed in pus. Mucous membrane of mastoid cells in the same condition. Lateral sinus completely obstructed by softening coagula. Purulent matter lay between the outer wall of the sinus and the bone. Same condition in superior and inferior petrosal sinuses.

“From the absence of any fetor, discoloration or softening of the bone it appeared that the lesion which caused death was essentially not a caries, but a suppurative phlebitis of the sinuses of the skull, propagated through the cells of the mastoid bone, from the inflamed mucous membrane of the middle ear.”

The change from the third to the fifth form probably takes place in the following manner :—The inter-cellular passages being closed, and the cells themselves filled with the swollen and congested mucous membrane, stasis follows in the local circulation, the bone becomes deprived of its nourishment, and the soft parts filling the cells break down into pus. The bony septa then either become dissolved, forming granular detritus, or separate as a connected whole from the surrounding healthy bone. The following cases afford good illustrations of the clinical features of this fifth form.

CASE XIV.—(N. Y. Eye and Ear Infirmary.)—William McClusky, a resident of Orange, N. J., æt. 21, of a healthy constitution, consulted me, Sept. 4th, 1872, for a painful affection of the mastoid process. He stated that in June he was seized with a severe pain in the ear after bathing. The pain continued for three or four days, and then stopped, leaving him quite deaf in the affected ear. At the expiration of two weeks a discharge appeared, and this had continued since until the 4th or 5th day previous to his visit to me. Shortly before the discharge stopped, he noticed some tenderness behind the affected ear. The pain, which for four days had been growing steadily worse, was referred to the mastoid region, whence it extended upwards and backwards to the parietal and occipital regions. Tinnitus. Appetite poor. Countenance pale. Watch heard at a distance of 4 inches on the affected side. The skin covering the mastoid process red and swollen. External auditory canal diminished in calibre by the falling forward of the posterior cutaneous wall. Membrana tympani invisible. Incision of the integuments covering mastoid process. Free escape of pus and blood. The periosteum was dissected up a short distance on either side and the underlying bone seemed healthy. The following day, Sept. 5th, while pressing pretty firmly against the bone with a steel director, it seemed to me that the point of the instrument met with less than the usual resistance. I then attempted to perforate the outer shell with a small steel drill, and in doing so suddenly exposed a large abscess which nearly filled the entire mastoid cavity. The opening was further enlarged with a conical drill until the little finger could be admitted, and the contents were then entirely evacuated. Tent inserted and patient allowed to return to his home where he said he could get further medical treatment. The incision of the integuments on the previous day had already greatly alleviated his sufferings.

On the 14th of November following he wrote:—"The pain never returned since you performed the operation, and the wound healed inside of ten days. I went to a doctor to have it dressed, but he refused to have anything to do with it, and said that it was a very dangerous operation, and might have killed me; so I went to a friend of mine and had it dressed. In ten days the outside was all healed, and I could hear a great deal better. Now I can hear my watch tick about twenty-four inches from my ear."

CASE XV. (New York Eye and Ear Infirmary).—Mrs. Sarah Curry, æt. 62, of a rather feeble constitution, consulted me July 10, 1872, for a painful affection of the left ear. Her story was that for many years she had been somewhat hard of hearing, especially in the left ear, but had never had any discharge from either ear. Two years previously she had an attack of facial paralysis, affecting the left side. After a certain length of time this passed off entirely. About nine weeks previously she began to suffer from pain in and behind the left ear and extending over the entire left side of the head. There was also tenderness behind the ear. For two days and nights the pain was severe. After that there remained a steady, dull aching, together with a moderate degree of tenderness behind the ear. Two weeks previously the acute pain again returned, and since then she had suffered pretty constantly up to the time of her visit to the Infirmary.

On examination the meatus was found nearly closed by a falling forward of the posterior cutaneous wall. Membrana tympani invisible. No appreciable tenderness in the meatus. No discharge. Tenderness over the mastoid process, and also over the lower part of the parietal bone. Watch heard when pressed against the ear. The patient's countenance was indicative of great suffering. Incision of the integuments and periosteum covering the mastoid process. No pus found.

July 13.—Little or no relief afforded by the incision. To-day the auricle is pushed forwards by a swelling behind the ear. Incision entirely healed. A second incision gave exit to about half an ounce of pus. No roughened bone or sinus discovered.

July 18.—Comparative relief from pain until last night, when the pain again became severe. She refers it to the mastoid process, the top and back of the head. The meatus is less swollen and the membrana tympani can now be seen. It is entire, but of a very tough, opaque, tendinous appearance. Eustachian tube open. The entrance of air is accompanied by râles. No brain symptoms. Consultation with Dr. Robert F. Weir. Mastoid process perforated with a conical drill. The outer surface of the bone found to be in every respect perfectly sound. At a depth of about one-fifth of an inch pus was found filling a cavity about the size of a filbert. Pus removed with pledgets of cotton, and outer orifice of the cavity enlarged sufficiently to admit the end of my little finger.

July 19. Patient much relieved by the operation, but she still complains of soreness over the back and side of the head. Pressure over the left occipital and parietal regions produces pain.

July 20.—Severe pain in the head, behind the mastoid process. Appetite only moderately good. Is losing strength. Stimulus ordered. Wound discharging freely.

July 22.—Still severe pain behind the mastoid process. Consultation with my father, Dr. Gurdon Buck. Skull trephined about three-quarters of an inch behind the mastoid process, at the point of greatest tenderness. The outer surface of the bone appeared to be perfectly healthy; but on withdrawing the trephine, after sawing through the outer table, the circular track was found to be filled with healthy pus, which had welled up from the intervening cancellous diploë. No appreciable softening of the bone. The removal of the inner button of bone exposed to view a tense, deep-red dura mater, but no pus. The subsequent oozing of venous blood from the ruptured branchlets was readily checked by laying a pledget of cotton-batting in the circular opening.

July 23, 11 A.M.—Patient slept a part of the night. This morning she has considerable heat of skin. Pulse 100 and feeble. Less pain in the head. Eight P.M. pulse 106 and feeble. Intellect perfectly clear. The discharge from the mastoid process appears to have nearly ceased. Vomited once this evening.

July 24, Noon.—Patient is evidently sinking. Pulse 110 and very feeble. Respirations 44. No râles over anterior and lateral portions of the chest. Intellect still clear, but she has not sufficient strength to speak in an audible tone when answering my questions. She died on the 26th, apparently from exhaustion.

Post-mortem examination refused by the friends.

The disease, if unchecked by operative procedure, may terminate in various ways:—

(a) In death, through basilar meningitis (Nos. 16 and 17); abscess of the brain (No. 18); embolus and pyæmia (No. 21); or exhaustion (No. 20).

(b) In recovery, after the extrusion of the carious

bone *en masse* or in fragments through an opening in the outer table of the bone, either behind the ear (No. 23), or in the external auditory canal (No. 22). If the caries has resulted in the formation of an abscess, the pus may find an escape through a similar opening. The carious process may also be followed by the growth of polypoid masses in the mastoid process (No. 24).

CASE XVI. (New York Eye and Ear Infirmary.)—Michael Casey, æt. 23, a sufferer from pulmonary phthisis, applied to me March 20th, 1872, for relief from a painful affection of his left ear. He stated that two months previously he first noticed a discharge from the left ear; that at first there was no pain connected with it, but that when the discharge became copious, as it did about two weeks before, he began to suffer from earache. On examination, the left meatus was found to be completely closed by a collapse of the upper cutaneous wall. After the speculum had been forced in for a certain distance, it encountered a mass of granulations, which obstructed a view of the deeper parts. Three leeches applied near the orifice of the meatus.

March 23. Better. The motion of the lower jaw produces pain in the left ear. Granulations removed with Blake's snare. Probe encountered denuded and roughened bone surface in the meatus.

March 30. Paralysis of the left side of face noticed to-day for the first time.

April 6. Œdema of the skin above and behind the ear. Incision over mastoid process gave escape to a large quantity of pus, a part of it lying between the periosteum and the bone, the surface of which was somewhat roughened. Occasional nausea to-day.

April 8. Is steadily losing strength. Pulse 112, and feeble. Suffers great pain throughout left side of head, but does not refer it to the mastoid region. On my advice the patient entered St. Luke's Hospital, where he could obtain proper food and nursing.

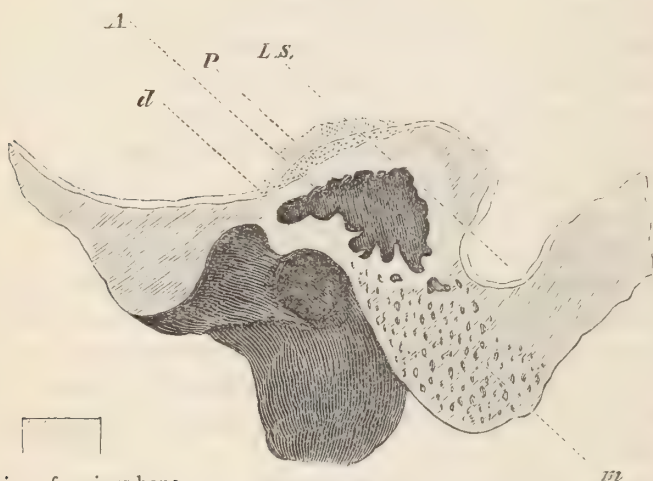
On the 9th of April, Dr. George A. Peters made a free incision through the upper wall of the meatus, exposing to view the denuded and roughened bone, and giving a free outlet to the pus that had accumulated above the auricle, and to that which was constantly forming

in the deeper parts of the ear, but had hitherto found an escape chiefly through the Eustachian tube.

The operation afforded the patient great relief; but in the course of a few days the temperature rose to 106° , the head symptoms became alarming, and the patient died comatose.

At the post-mortem examination, the dura mater covering the convexity of the left hemisphere was found to be intensely red; on the right side it was nearly normal. Pus at the base of the brain on the left side. Dura mater covering the left tegmen tympani thickened,

FIG. 6.



Region of carious bone.

d—dura mater; very much thickened over antrum.

A—antrum.

L.S.—lateral sinus.

P—pus collected between dura mater and bone.

m—mastoid process.

(Antero-posterior vertical section. Natural size.)

(Case No. 16.)

and of a maroon color. The thickened portion, whose limits were very abrupt, could easily have been mistaken for a swollen Peyer's patch, as seen in typhoid fever, so close was the resemblance between the two. Between the swollen dura mater and the greenish, softened

tegmen tympani lay quite a collection of cheesy, disorganized pus. The lateral sinus was not involved. The antrum mastoideum was nearly filled with a cheesy mass enveloped in a coating of foul greenish pus. The mastoid cells were sclerosed. A small sinus led from the outer surface of the upper portion of the process directly inwards to the antrum. (It was not detected during life.) The tympanum was filled with the same greenish, foul pus, which had also accumulated in the vestibule and scala tympani, owing to the destruction of the stirrup and membrane of the round window. The lining mucous membrane of the tympanum was not recognizable; the pus seemed to be lying in direct contact with the bone. Membrana tympani totally destroyed. The cavity of the temporo-maxillary articulation filled with pus. Eustachian tube ulcerated and very much enlarged. The pus had also burrowed down in the direction of the basilar process of the occipital bone.

CASE XVII.—On the 21st of September, 1872, I was asked by Dr. Hermann Knapp to see with him, in consultation, a Mr. F., æt. 57, and of a strong constitution. The history of the case was briefly this: During the previous ten or twelve years Mr. F. had had five distinct attacks of acute purulent inflammation of the left middle ear, from all of which he made a good recovery. The present attack began about seven weeks previously, and was characterized by headache and dullness of hearing, unaccompanied by discharge. On examination of the ear Dr. Knapp found the external auditory canal swollen, especially on the posterior side; the membrana tympani injected, and the mastoid process tender on pressure. In the progress of the disease, the membrana tympani becoming more congested and convex outwardly, the doctor incised it. No pus escaped, but the patient experienced relief from his suffering for about a week. The pain then returned, and the integuments covering the mastoid process became swollen. The patient also noticed a gurgling sensation in the ear, whenever he shook his head. An incision down to and through the mastoid periosteum afforded only temporary relief. The pain again became severe. At the consultation (Sept. 21) it was decided that perforation of the mastoid process was the only course that offered any hope of recovery. The patient however refused.

Sept. 22. Up to this time there had been no brain symptoms, but

to-day, being called in haste to see the patient during the absence of Dr. Knapp from the city, I found him unconscious, pupils non-responsive, face flushed, and head very hot; pulse about 120, and full; breathing stertorous. The friends were then willing enough to have the operation performed, but it was clearly too late. The patient died the same night.

At the post-mortem examination, purulent basilar meningitis was found, together with a free communication between the mastoid antrum and the cavity of the lateral sinus. The two formed together an irregularly-shaped cavity filled with pus. The pus did not extend down into the jugular vein, nor back toward the torcular Herophili. Both these portions of the vein contained venous blood. Sclerosis of the mastoid cells. *Membrana tympani* entire.

CASE XVIII. (Reported by Von Troeltsch in the "*Archiv für Ohrenheilkunde*," Vol. IV.)—A girl, æt. 20, of habitual good health, but affected for more than ten years with a discharge from the left ear, began to complain in November, 1866, of frequent headaches. Her family also noticed that she was depressed in spirits. On the 6th of January, 1867, the headache returned with great severity. On the 8th of January the family physician was sent for. He found her somewhat feverish, pulse 96, occasional vomiting; she complained of great pain, of a boring, lancinating character, in and around the left ear. Fetid otorrhœa. Ordered six leeches to the ear, cold applications to the head, and calomel internally.

January 9. Pain still severe. Vomiting. Pulse 110. Ordered six leeches to ear.

January 10. Pain less severe.

January 11. Delirious during the night. Pulse 120. Ordered leeches for the fourth time.

January 13. Some stupor. Pulse 140. She died on the 14th.

At the post-mortem examination an abscess was found in the left cerebellum, and one also in the left lower lobe of the cerebrum. Discoloration and thickening of the dura mater over the tegmen tympani. Discoloration of the bone near the mastoid antrum, which was filled partly with a greenish pus, and partly with cheesy material. Mucous membrane of the tympanum green, swollen and ulcerated. The *membrana tympani* very much thickened and defective in the upper and

posterior portion. (This, however, may have been artificially produced by the saw). The vestibule of the labyrinth filled with a brownish semi-fluid substance.

CASE XIX. (Reported by Ludwig Mayer in the "*Archiv für Ohrenheilkunde*" Vol. I.)—A boy, *æt.* 15, of good health, was attacked July 10th, 1864, with a severe pain in the region of the left ear, chiefly behind it. For fifteen months previously he had been troubled with a discharge from that ear. An examination of the parts revealed swelling and tenderness over the left mastoid process.

July 13. Patient had a chill to-day. Steady increase in the severity of the pain. Dizziness, fever and loss of appetite. Pulse 130. Discharge fetid. Motion of jaws painful. Meatus filled with pus, but not tender on pressure. Membrana tympani entire and of a milky hue. Polypoid granulations on the upper wall of the meatus near the membrana tympani (Dr. Mayer states that probably a sinus led from this portion of the meatus into the cells which often lie above it.) Incision over mastoid process. Surface of bone rough. Perforation performed with a trocar. Very little pus found. Ordered poultices.

July 14. Much better. Pulse 72.

July 16. Chill followed by sweating. Pain in head. Ordered fifteen leeches to the left mastoid region. Discharge from the meatus has ceased.

July 17. Double vision. Several passages from the bowels. Chill.

July 18. Delirium.

July 20. Comatose. Patient died on the 22d July.

Post-mortem examination not allowed.

CASE XX.—Mr. I. H. N., *æt.* 40, a sufferer from pulmonary tuberculosis, was sent to me in consultation by Dr. William Hyde, of Stonington, Conn. He stated that he became somewhat deaf in the left ear eight years previously. In the autumn of 1871 he was attacked with pain, roaring and throbbing in the left ear, followed in the course of a week by a discharge. Since then the discharge had never ceased, and there had always been more or less pain. On one occasion he found a small fragment of bone in the discharge. Pain pretty severe recently, but not referred specially to the mastoid process.

The condition of the patient at the time I saw him was that of a person advanced in phthisis. An examination of the ear revealed a

marked degree of deafness, tenderness over the mastoid process, and pus escaping from the meatus, which was quite blocked up by the presence of a mass of granulations, springing from the upper and posterior cutaneous wall. During the exploration I extracted four loose fragments of bone, which were evidently bony septa from the mastoid cells. By aid of a curved probe I ascertained that a sinus led from the meatus (quite near the outer end of the osseous portion) backwards into the very centre of the mastoid process. In its course the probe encountered two or three sharp projecting spiculæ of bone. The patient was so feeble that I was obliged to desist from further exploration.

On the 28th of September following the patient died, with no other symptoms than those of exhaustion. Two days before death, there was a considerable hæmorrhage from the ear.

No post-mortem examination made.

CASE XXI. (Reported by Von Troeltsch, in the "*Archiv für Ohrenheilkunde*," vol. iv.)—Patient entered the hospital March 30th, 1866. She was 21 years of age, and in the sixth month of pregnancy. She complained of daily chills followed by fever and sweating. During these attacks she suffered from severe frontal headache. The diagnosis of febris intermittens was made, and quinine prescribed in moderate doses. On the 5th day a purulent discharge from the right ear was discovered. The patient said it had existed for three years. On examination œdema and redness of the skin were found in the neighborhood of the ear, and extending back toward the occiput. Meatus swollen and filled with thick pus. Treatment: frequent syringing of the ear with warm solutions of acetate of lead; blister to the mastoid process; poultices. On the seventh day some delirium. Right pupil more dilated than the left. The chills continued in spite of large doses of quinine. On the 13th of April the child was born. It lived but a few hours. On the 15th diarrhœa; patient comatose; increase of swelling around the ear. April 17. Profound coma and death.

At the post-mortem examination the following pathological conditions were found: phlebitis of the right lateral sinus. Metastases in the lungs. Tissues around the right ear infiltrated with pus. Pia mater of the right hemisphere much congested. Dura mater along the right lateral sinus very vascular, and of a greenish hue. Within the sinus

transversus a purulent, yellowish-red material. Along the upper surface of the petrous bone, beneath the dura mater, two distinct collections of a creamy, yellowish-green pus. Beneath one of these collections, the bone was found to be rough and discolored. Pus between periosteum and right mastoid bone, whose outer surface was discolored. Upper and posterior wall of the meatus decidedly swollen. Membrana tympani intact but very much thickened, and of a bluish red color. Bony roof of antrum perforated by caries. Antrum itself entirely filled with cheesy pus. The cells of the mastoid process converted into a large cavity containing discolored pus and fragments of bone. The adjacent bone green. The cells immediately above the meatus filled with thickened, discolored pus; lining membrane everywhere much thickened and congested. Tympanum filled with dried pus.

CASE XXII.—(Reported by Dr. Chas. Laight in the Transactions of the American Otological Society, July, 1871.)—William Quinn, æt. 13, of good health, was admitted to the N. Y. Eye and Ear Infirmary July 5th, 1871. He stated that six years previously he had been sick with a painful affection of the left ear followed by a discharge which had continued ever since. Present condition:—Pain in the ear. General condition good. An examination of the ear revealed the presence of a loose mass of bone in the meatus; it was attached only by a small fleshy peduncle to the upper cutaneous wall. Discharge very fetid. Bony mass removed. On examination it proved to be a portion of the mastoid process, about the size and shape of a small bean, which had come away as a single sequestrum. Further examination revealed the existence of a correspondingly large sinus, leading from the external meatus back into the adjacent mastoid cells.

The pain passed off at once, after the removal of this large sequestrum, and the otorrhœa soon after ceased entirely under appropriate treatment.

CASE XXIII.—A. B., æt. 15, of robust health, consulted me on the 28th of September, 1871, for a deafness of the left ear. The history of the case, so far as I could ascertain it, was as follows:—When a small child he had measles, followed by inflammation of the left ear. For several years subsequently there was a discharge from the outer orifice

and some difficulty behind the ear, but exactly what was the nature of that trouble he could not recollect. For the past three or four years, however, he had been entirely free from otorrhœa.

On examination I found evidences of a former purulent inflammation of the left middle ear. Behind the ear there was a deep depression in the skin, corresponding to a similar depression in the mastoid process, a large portion of which had come away, either *en masse* or in fragments, through an opening on the outer side of the bone. This depression was large enough to admit the end of my little finger.

CASE XXIV.—(N. Y. Eye and Ear Infirmary).—Catherine Bergeman, æt. 42, of healthy appearance, consulted me February 7th, 1872, with reference to a polypus in the right ear. Her history was simply this:—From childhood she had always been troubled with a discharge from the affected ear, and had first noticed the existence of the polypoid growth about six years previously. On inspection I found a rather tough, fleshy mass, presenting at the outer orifice, and extending out a little distance from it. With Blake's snare I succeeded in extracting the mass entire. The subsequent hemorrhage was moderate and soon ceased of itself. An examination of the parts then showed that this large polypus (length $1\frac{3}{4}$ in., greatest diameter $\frac{3}{8}$ in.) sprang from the farther end of a broad sinus, which led from the external osseous meatus far back into the mastoid process. No exposed bone could be felt with the probe. No trace of *membrana tympani* or ossicles.

Four days later I again saw the patient and ascertained that there had been no discharge since the removal of the polypus. Subsequently she did not make her appearance.

These cases will serve to illustrate the chief characteristics of mastoid diseases, with the course they pursue either towards a favorable or a fatal issue. In concluding this portion of the subject, I shall briefly recapitulate the symptoms that will lead us to diagnosticate between these different varieties, and then take up the question of treatment.

In simple periostitis we have tenderness on pressure,

pain and swelling of different degrees. If we find the external auditory canal inflamed, without any appreciable trouble in the middle ear, we may feel pretty sure that the inflammation is limited to the outer fibrous textures. The pain too is not so deeply seated, nor has it the same intensity as when the cells themselves are affected. Pus occasionally results from this inflammation.

In simple congestion of the mucous membrane we may expect to find tenderness on pressure, pain and swelling of the integuments. If we remember that this is simply an extension of the diseased process from the middle ear, the difficulties in diagnosis will be materially lessened. As a rule, we shall find the pain more intense and deeper seated than in simple periostitis, and the external auditory canal will be unaffected. The relief which follows local depletion or an incision will distinguish it from other mastoid diseases.

Chronic subacute inflammation is not characterized by any definite train of symptoms. Its existence can only be shown by direct physical examination.

In the two remaining forms, it is scarcely possible to make a differential diagnosis, except perhaps in certain well-marked examples. This, however, is unnecessary, for the treatment in both cases is the same. The symptoms of pain and tenderness on pressure are almost invariably present. Dr. Roosa's case (No. 25 of the statistical note) is the only exception I know of. These two symptoms will not be permanently relieved by local depletion, or incision of the integuments or membrane. In some cases there is an entire absence of swelling. There are certain other phenomena observed in these

two forms which vary more or less in constancy. They are so valuable as aids to diagnosis that I shall mention them somewhat in detail.

(*a.*) Prolapse of the posterior or superior wall of the external auditory canal has been noticed in a few cases. In all of them it seemed to be associated with caries of the meatus. Swelling and tenderness of the posterior wall are frequently present in both forms.

(*b.*) Brain symptoms do not always indicate uniform pathological conditions. They may occur in inflammation with or without pus. They may also be absent when there is extensive caries of the part with local meningitis.

(*c.*) Facial paralysis is an occasional intercurrent symptom, and usually indicates that the bony walls of the tympanum, in which the nerve is embedded, have become involved.

(*d.*) Cessation or marked diminution of the purulent discharge is the usual precursor of acute mastoid inflammation.

(*e.*) In rare cases the membrana tympani remains entire.

(*f.*) The discharge of pus through the Eustachian tube indicates that some obstruction exists preventing its escape by way of the meatus.

(*g.*) The presence of granulations, springing from either the upper or posterior wall, should lead us to suspect that there is an opening leading to the mastoid cells. This fact can easily be ascertained by exploration with a bent probe.

Treatment.—The preceding cases illustrate so fully the methods of treatment to be adopted, that we have nothing new to add. We shall, therefore, simply give a brief recapitulation.

In the earlier stages of disease, when there is merely pain, tenderness on pressure, and perhaps swelling in the mastoid region, the most prompt relief can be afforded by local depletion. Apply from four to ten leeches, and follow them with warm fomentations. The external auditory canal and middle ear should then be carefully examined and treated according to indications. No reliable exploration can be made without the speculum and reflector.

If these measures do not give relief, and the unfavorable symptoms persist, a free incision through the integuments and periosteum of the mastoid process should be made.

The knife should enter at the level of the upper wall of the meatus, about $\frac{1}{4}$ inch posteriorly to the insertion of the auricle, and should extend downwards nearly to the tip of the process.

Should this latter procedure also fail, the bone should be trephined or perforated in such a way as to expose the mastoid cells.

This latter operation has now been repeated so many times that its great value and comparative freedom from danger have been securely established. It may be easily performed and will enable us to save life in a large majority of cases where a fatal termination is imminent.

Out of thirty-one cases (see statistical note), in which

the operation has been performed, the progress of the disease was arrested in twenty-three ; in the remaining eight fatal cases, death could not be attributed to the operation, directly or indirectly, in more than one case (No. VII). In the remaining seven cases the operation was performed too late : pyæmia had already developed itself, or there was already inflammation of the brain or its membranes ; or pus in the lateral sinus.

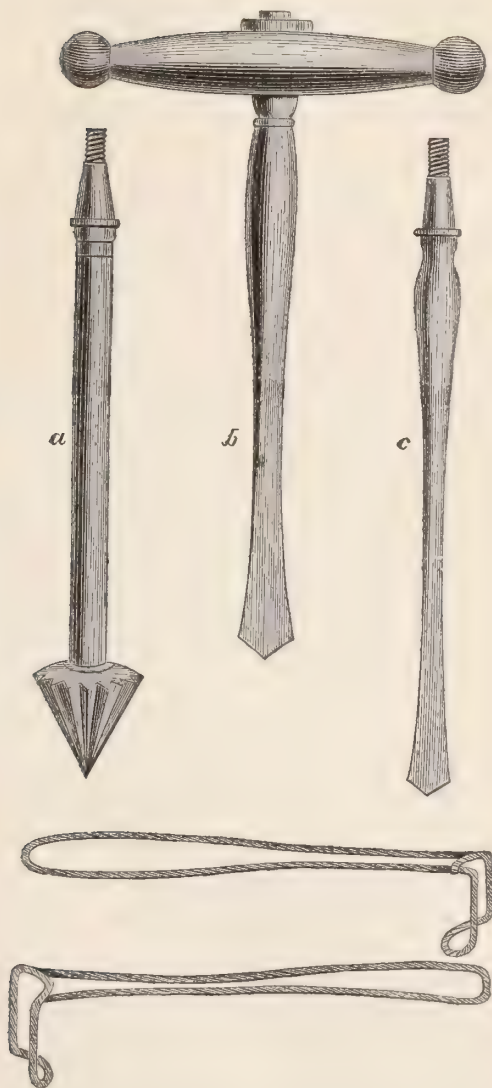
Some surgeons discountenance the operation in young persons, and claim that the disease in such cases will almost always terminate in recovery by a spontaneous perforation of the outer bony wall.

The incorrectness of this view will be shown further on in the statistical note. We are unable to judge of the comparative fatality of such cases from the insufficiency of our data. It will be seen, however, that a sufficient number of fatal cases are on record to make it unsafe for us to trust to natural processes only.

The steps of the operation are briefly as follows :—

A free vertical incision should be first made through the integuments and periosteum of the mastoid bone. The condition of the bone should then be noted. If it be soft or roughened, an attempt should be made to break through the outer lamella by firmly pressing upon it with the end of a steel director. If pus be found between the periosteum and the bone, search should be made with a bent probe for a sinus through which the pus may have found an escape from the mastoid cells. If such a one can be found, apply the drill or trephine at this point, and simply enlarge the existing opening. If no opening be found, dissect up

FIG. 7.



Drills for perforating the mastoid process.
Retractors.

the periosteum from that portion of the mastoid process which is situated immediately behind the external auditory canal, and apply the trephine or drill* at a point a quarter of an inch distant from the canal and a little below the level of its upper wall. The drill should be rotated in a direction inwards, forwards, and a little upwards: that is, nearly parallel with the canal. The depth to which the instrument should be carried will vary in different cases. The aim should be to reach the peculiar cell-structure of the mastoid process. If the patient be an adult, and the case be one where sclerosis of the mastoid cells existed before the development of the acute symptoms, it may be necessary to penetrate to a depth of three-fifths of an inch to reach the mastoid antrum, the usual center of disease in such cases. Ordinarily, however, the fragile cell-structure will be found at a depth of a fifth of an inch. The drill can then be withdrawn and the steel director used to break down the bony septa. In infants the antrum is situated so near the outer surface of the bone that very little effort will be required to establish the desired opening. The only danger connected with this operation is that of wounding the lateral sinus.†

The after-treatment consists in:—*a*, inserting a tent of lint to prevent union by adhesion: this tent should

* The drill appears to me to be preferable to the trephine. Fig. 7 gives the actual size of the three different drills best adapted to this purpose.

† In Dr. Weir's case (No. 27 of table of operations) the outer wall of the sinus was exposed over a circular space a third of an inch in diameter. At the post-mortem examination, twelve days later, this part was examined very carefully, and yet no trace could be detected of any inflammatory action, either in the fibrous wall or in the neighboring bone.

be replaced by fresh ones at least once in twenty-four hours, until suppuration is freely established; *b*, poultices, until the pain moderates and free suppuration becomes established; *c*, carbolic acid dressings and lotions frequently repeated.*

STATISTICAL NOTE.

The following statistics are based upon the record of sixty-seven cases, a small portion of them taken from my own case-book, the majority from the various medi-

* Lallemand (*Recherches anatomico-pathologiques sur l'encéphale*. Vol. II., p. 87. Paris, 1825), relates the following narrative as an illustration of how these cases may become the subject of medico-legal inquiry:—

J. Conrard, æt. 20, pale, thin, and of a feeble constitution, was struck several times while quarreling with another boy, and in consequence fell sick. He had all the symptoms of an ataxic fever and died on the 20th day.

The magistrate, believing that death might have been produced by the blows the boy had received, ordered the body to be opened and examined. The physicians reported “that they had found:—1, the brain rather more congested than natural; 2, a thin layer of pus between the under surface of the brain and the dura mater; 3, a collection of pus in the anterior portion of the right lobe of the cerebellum; 4, the arachnoid in contact with the right petrous bone, adherent to the dura mater and of a deeper red than normal.”

A superficial observer would have felt justified, in the presence of such ample evidence, in attributing the boy's death to the blows he had received twenty days previously. Happily, the physicians, whose duty it was to enlighten the consciences of the jury, were not hasty in arriving at a conclusion. As there was no trace of any serious contusion on the surface of the cranium, and as the abscess was contained in a well organized cyst, they questioned the boy's parents about his antecedent history, and ascertained—thanks to their truthfulness—that their son had been troubled with his head for a long time previously, and had been subject to attacks of pain in the right ear. The physicians then returned to the body and made a further examination of the temporal bone, which resulted in their finding the mastoid cells filled with pus, and the middle ear similarly affected. They then reported “that the disorganization which they had found must have existed already before the occurrence of the fight and had no connection with it: that it was simply possible that the blows may have hastened the course of the disease.”

cal periodicals and works on otology which were within my reach. Only those cases were taken in which the post-mortem examination or the clinical history afforded unmistakable evidence that the mastoid cells were diseased (third or fifth form).

Out of sixty-seven cases I found that thirteen occurred in children 10 years of age and under,

26 in persons between the ages of 10 and 25,

9	"	"	"	25	"	40,
12	"	"	"	40	"	55, and
7	"	"	"	55	"	62.

The youngest patient was 8 months old, the oldest 62 years. More than half of the patients were under 25 years of age. Six of the cases belonged properly to the third form, two were doubtful (third or fifth), and the remainder belonged to the fifth. Of the entire number three terminated in a spontaneous recovery, twenty-two were operated upon and recovered, eight were operated upon and died, and the remainder, thirty-six in all, terminated fatally. All the cases of spontaneous recovery occurred in persons under 16 years of age.

TABLE OF OPERATIONS ON THE MASTOID PROCESS.

No.	Where reported and name of operator.	Age.	Form of disease.	Otorrhoea.	External appearances of the bone.	Instrument used.	Result.
1	Jasser, 1776.... (Arneman's Bemerkungen über die Durchbohrung des Processus mastoideus. Göttingen, 1792.)	Adult.	Simple deafness.	None.	Normal.	Trocar.	Recovery from operation.
2	Fielitz..... (Ibid.)	Young Adult.	Not clearly stated.	Present.	Not stated.	Some kind of borer.	Recovery
3	Fielitz..... (Ibid.)	An old woman	Simple deafness.	None.	Normal.	Same.	Recovery from operation.
4	Löffler..... (Ibid.)	Adult.	Simple deafness.	None.	Normal.	Same.	Recovery from operation.
5	Hagstroem..... (Ibid.)	Adult.	Simple deafness.	Not stated.	Normal.	Gouge.	Recovery from operation.
6	J. L. Petit..... (Von Troeltsch's work on Otol-ogy.)	Not stated.	Not stated.	None.	Not stated.	Gouge.	Recovery
7	Weber..... (Mentioned by Von Troeltsch in Virchow's Archives, vol. xxi.)	44	5th.	Present.	Not stated.	Not stated.	Recovery
8	Forget..... (L'Union Médicale, 1860, No. 52.)	14	5th.	Present.	Not stated.	Not stated.	Recovery
9	Follin..... (Gazette des Hôpitaux, 1864.)	44	5th.	Present.	Not stated.	Trephine.	Recovery
10	Ludwig Mayer.. (Archiv für Ohrenheilkunde, vol. i.)	15	5th.	Present.	Roughened	Trocar.	Death from pyæmia.
11	Flaiz..... (Arch. für Ohrenh., vol. ii.)	46	3d.	Present.	Normal.	Drill.	Recovery
12	Jacoby..... (Archiv. für Ohr., vol. iv.)	48	5th.	Present.	Pus on the outer side of bone, but no roughness or softening.	Drill.	Recovery

TABLE—CONTINUED.

7. 8.	Where reported and name of operator.	Age.	Form of disease.	Otorrhœa.	External ap- pearance of the bone.	Instrument used.	Result.
13	Jacoby (Archiv für Ohr, vol. vi.)	10	5th.	Present.	Not stated.	Drill.	Recovery
14	Jacoby (Ibid.)	37	5th.	Present.	Not stated.	First with drill, later with tre- phine.	Death.
15	Jacoby (Archiv, vol. v.)	20	3d.	Present.	Normal.	Drill.	Recovery
16	Kessel (Archiv. für Oh- renh., vol. iv., p 58.)	24	5th.	Present.	Not stated.	Trocar.	Recovery
17	Pagenstecher ... (Mentioned by Jacoby, in the Archiv. für Oh- renheil., vol. iv., p. 222.)	60	5th.	Present.	Not stated.	Cartilage knife.	Recovery
18	Pagenstecher ... (Ibid.)	Not stated.	Not stated.	Present.	Not stated.	Drill.	Recovery
19	Hinton (Med. Times & Gazette, Sept., 1868.)	58	5th.	Present.	Not stated.	Trocar.	Recovery
20	Colles (Dublin Quarter- ly, Aug., 1870)	Middle Age.	5th.	Present.	Not stated.	Drill.	Recovery
21	Buszard (British Med. Jour., Jan., 1871.)	40	5th.	Present.	Small sinus in upper portion of mastoid process.	Trephine and chisel.	Recovery
22	Barwell (Lancet, April, 1871.)	6	5th.	Present.	Softened at one point.	Pointed gouge.	Recovery
23	Barwell (Ibid.)	47	5th.	Present.	Not stated.	Same.	Recovery
24	Stokes (Dublin Med Jour., Aug., 1870.)	49	3d.	Present.	Normal.	Semi-circu- lar saw.	Death.
25	Agnew (Trans. Amer. Otol. Society, 1870.)	Middle life.	5th.	Present.	Small sinus.	Trephine.	Recovery
26	Roosa (Ibid.)	38	5th.	None.	Small sinus.	Not stated.	Death.
27	Weir, N.Y. City (Reported ver- bally. I was also present at the operation.)	12	3d.	Present.	Normal.	Drill.	Death.

TABLE—CONTINUED.

No.	Where reported and name of operator.	Age.	Form of disease.	Otorrhœa.	External appearance of the bone.	Instrument used.	Result.
28	Laight, N. Y. City (Reported verbally. I was also present at the operation.)	45	5th.	Present.	Normal.	Drill.	Recovery
29	North Waterbury, Ct. (Reported verbally.)	19	3d.	Present.	Normal.	Trephine.	Death.
30	Buck	62	5th.	None.	Normal.	Drill.	Death.
31	Do.	11	3d.	Present.	Normal.	Drill.	Death.
32	Do.	21	5th.	Present.	Softened.	Drill.	Recovery
33	Do.	56	3d.	Present.	Normal.	Drill.	Recovery
34	Do.	47	5th.	Present.	Normal.	Drill.	Recovery
35	Do.	36	3d.	Present.	Normal.	Drill.	Recovery

The cases of Jasser, Von Troeltsch, and Turnbull are omitted from the list simply because I can find no evidence in the printed reports of these cases that any operation was performed upon the bone, beyond the mere introduction of a buttoned probe into a small fistulous opening. Other cases have been omitted through inability on my part to gain access to the printed reports. The names of these surgeons are Pagenstecher, Schwartze, and Von Bruns.

A SYSTEMATIC METHOD FOR TESTING AND RECORDING THE ACUTENESS OF HEARING.

By H. KNAPP.

FOR some years I have been in the habit of testing and recording the acuteness of hearing in a manner similar to that which has become general for the determination of the acuteness of vision. In the winter of 1871 and 1872 I described this method, both in my lectures on Otology and at a meeting of the New York Ophthalmological Society. By the discussion of the subject in this Society, I learned that Dr. J. S. PROUT, of Brooklyn, was in the habit of recording the acuteness of hearing in a similar manner, which, shortly after that meeting, he described in the weekly "Boston Medical and Surgical Journal," Feb. 29, 1872.

Neither the mode of examining nor that of recording I am going to describe, offers anything particularly new, but it has the advantage of combining the ordinary tests in a method, and of recording the results in a way both simpler and more comprehensive than the clumsy phraseology used in otological literature.

The basis of our considerations is the *expression of the degree of deafness by a fraction of the normal standard of hearing power*. There are some difficulties to be overcome which do not exist in the determination of the acuteness of vision: we have no test for the sharp-

ness of hearing that compares, as to uniformity and universal applicability, with the test types of oculists. Moreover, we have to examine the ear for its power to perceive different *qualities*, not solely different *intensities*, of sound. These qualities are: *noises*, *musical tones*, and, what is more important, the *human voice*, a mixture of music and noise.

The minimum intensity of each of these qualities of sound, perceived by the majority of people with healthy ears, determines the normal standard of hearing. The increase of the intensity of sound required by a defective ear, indicates a proportional diminution of the normal hearing. We have to determine the minimum intensity of each quality of sound in each ear, and compare it with the normal minimum. This comparison expresses the acuteness of hearing as a fraction of the normal. If we had an instrument of general applicability with which we could measure the intensity of sound, nothing would be easier than to determine the acuteness of hearing. As long as we have no such instrument, we must do the best we can with the means that are now at our command.

The best instrument to test the hearing of *noises*, is a watch. A ticking clockwork might be made for this purpose alone, and used by aurists as generally as Snellen's or Jäger's test types by oculists, which would bring uniformity into our examinations. I leave that to our colleagues in Germany and Switzerland. Until then every aurist will have to use his watch the hearing distance of which he knows. My watch is heard, in my consultation-room, by the majority of people between

30 and 45 years of age, at a distance of *ten feet* from the ear. If a person hears this watch at 10', I denote his hearing power for noises $h = \frac{1}{10}$, *i. e.*, 1, or normal.*

Children, as a rule, hear more acutely than adults, and frequently have $h = \frac{1}{10}$; while people over 50 rarely exceed $h = \frac{3}{10}$ to $\frac{8}{10}$. This shows that the acuteness of hearing at different periods of life varies more than the acuteness of sight. If we bear that in mind, the above expression will give us a correct notion of the degree of the impairment of hearing.

If a patient hears a watch of 10' normal hearing distance at 2', his hearing is only one-fifth of the normal standard, but instead of writing it $h = \frac{1}{5}$, it is preferable to write $h = \frac{2}{10}$, because this at the same time shows how the value was obtained, and can be read in the words at the beginning of this sentence. I prefer to use the numbers in such a way that they not only show the fraction of hearing acuteness, but also the mode of examination; for instance, if the watch is heard only at 1 inch, I write $h = \frac{1}{12 \cdot 10}$, and do not reduce the fraction to its simplest expression, or if I do, I place it after the unreduced fraction; for instance, $h = \frac{1}{12 \cdot 10} = \frac{1}{40}$, which shows that the patient whose hearing acuteness for

* Being accustomed to use the letter "*H*" for hearing power in general, I formerly expressed the hearing of noises, the voice, and music with indices as *Hn*, *Hv*, and *Hm*: Dr. Prout uses *H* (horologium) for the watch, *V* (vox) for the spoken voice, and *V. S.* (vox susurrata) or simply *S* (susurrus) for the whispered voice. He uses moreover the following abbreviations: *P. A.*, potentia auditus, for hearing power, *A. D.* and *A. S.*, auris dextra and auris sinistra, for right ear and left ear, and expresses the hearing distance in inches. This gives longer formulæ than is necessary. For the sake of brevity I have adopted two of Dr. Prout's abbreviations, *h* instead of *Hn*, and *v* instead of *Hv*; *s* is unnecessary, but *m* for *Hm* has to be added.

noises is $\frac{1}{40}$ of the normal standard, hears a watch of 10' hearing distance at 3''. Fractions of an inch I place either in the numerator, as $h = \frac{1\frac{1}{2}}{1\frac{1}{2} \cdot 10}$, or leave only the unit in the numerator and place all the other numbers in the denominator, as $\frac{1}{2 \cdot 12 \cdot 10}$; both of which show at once that the watch is heard at half an inch. If a patient hears the watch only in contact with the auricle, I record it $h = \frac{1}{\infty}$, and if he does not hear the watch at all, it is $h = 0$. For the right or left ear, the initials *r* and *l* are added. The terms *r* $h = \frac{1\frac{1}{2}}{12 \cdot 10} = \frac{1}{20}$, *l* $h = \frac{1}{3 \cdot 12 \cdot 10} = \frac{1}{360}$, etc. will now not only be easily understood, but read in the usual phraseology.

The determination of the acuteness of hearing the *voice*, which we shall denote by the letter *v*, is of the greatest practical importance. *V* cannot be ascertained with the same uniformity as *h*, but by some attention it may be tested with sufficient accuracy for all practical purposes. We have to distinguish *whispered* and *spoken* voice. I have practised *whispering* so loud—and no louder—that persons with healthy ears understand it at a distance of *twenty* feet (the length of my consultation-room). Moreover, I have found when I speak moderately loud in my consultation and waiting rooms, that I am understood by people with normal hearing at a distance of *sixty* feet. Every physician may, by some practice, graduate his whispering and spoken voice in such a way, that he can use it as a test for the sharpness of hearing adapted to his own consultation-room. He will also soon learn what words are more easily understood than others, and take this into account in estimating the hearing power of his patients. Moderately loud

whispering being understood at the distance of 20', and moderately loud speech at the distance of 60', 20 and 60 in the denominator of the fractions expressing v , always mean whispering, respectively spoken voice.

Examples:—

$v = \frac{20}{20}$ means whispering is heard at the normal distance;

$v = \frac{60}{60}$ means a person's acuity of hearing for ordinary voice is normal;

$v = \frac{30}{20}$ means that whispering which a healthy ear hears at 20', is heard only at 3';

$v = \frac{5}{60}$: the voice which should be heard at 60', is heard only at 5'.

$v = \frac{1/2}{60} = \frac{1}{120}$: voice of 60' hearing distance is heard at $\frac{1}{2}$ '.

$v = \frac{1}{\infty}$ means quantitative perception of sound, that is, the patient hears the voice, but is not able to understand words.

$v = 0$: no voice is perceived.

In testing v , I follow the customary rules: the patient turns his ear towards the speaker, closes the other ear, and repeats the words.

To test the acuteness of hearing for musical sounds m , I use a small musical box,* the sounds of which are heard by a healthy ear 80' distant. It is hardly necessary for me to give examples for its use: $m = \frac{10}{80}$ means a musical box the tune of which is normally heard at a distance of 80', is heard at 10'; $m = \frac{1}{\infty}$ means quantitative

* The smallest I could find, playing two tunes, the notes of which are of a high pitch, a condition not unimportant.

perception of musical sounds, but no tones or melodies are distinguished; $m = 0$: no musical sounds at all are perceived.

I need hardly add that in testing the hearing power for any quality of sound, the test object has at first to be held far off and gradually approached until it is distinctly heard; this distance is recorded. Going in the opposite direction, removing the test object from the ear till it is no longer heard, we obtain greater and less uniform values, which is in accordance with the law of the acuteness of all perceptions. As I use the letter H for hearing in general, $H=0$ means absolute deafness, and $-H$ may be an abbreviation for diminution, impairment, or hardness of hearing.

The method above described of testing and recording the acuteness of hearing is analogous to the determination of the acuteness of sight; it would seem to answer the purposes of the aural practitioner; it is certainly comprehensive, and saves a good deal of writing; advantages which, I trust, make it worthy of being submitted to the profession.

ON THE TREATMENT OF SOME EYE DISEASES BY MEANS OF THE CONSTANT CURRENT.

BY DR. DRIVER, OF CHEMNITZ.

Translated by Dr. C. C. Terry, of New York.

IF we may judge from the scanty contributions upon the use of the constant current in eye diseases, it would appear that galvanism as a therapeutic agent has not won extensive favor amongst the oculists. It is, on this account, my purpose in this place to recommend to my colleagues, in the warmest terms, a remedy, which the more I have used it in opportune cases has given the more surprising results, and to give from my somewhat extended experience some hints as to the method of using it; for, as is well known, electrotherapy depends mostly upon the method.

I employ in the treatment of eye disorders the constant current only—for the induction current, although so valuable in other diseases, has in my hands, though often tried, never shown a trace of effect,—and the apparatus I use is the so-called hand-plate battery with carbon-zinc elements of Dr. Stöhrer, of Dresden.*

* This plate-battery with a contrivance for raising and immersing the plates, a sliding bar to combine them, and a commutator, unites cheapness—which is a matter of some importance—with transportability. If used on an average six times a day, it preserves its constancy during several months. No rheostat is necessary for eye disorders. For reophores I use pieces of sponge moistened with solutions of salt, that for the anode being larger than that for the cathode.

The application may be made in three ways, according to the kind and seat of the disorder: *a*, through the head, either longitudinally:—anode on nucha and cathode on the right or left frontal protuberance, or transversely:—anode and cathode on each temple or both mastoid regions; *b*, galvanization of the sympathetic on one or both sides; anode on nucha and cathode on region of upper cervical ganglion, *i. e.*, the angle of lower jaw; *c*, locally on the eye; anode on nucha and cathode on the closed lids. The anode is always stable, but I prefer the cathode unstable. Duration of a sitting usually 1–2 minutes. Number of elements as required; as a general direction it should be remarked that in no case should there be pain or dizziness *during* or headache *after* the sitting. Generally 6–8 elements suffice for the head, 6–14 for the neck.

The diseases in which the constant current is recommendable are the following:—

I.—*Neuroretinitis in consequence of cerebral processes*
—*neuroretinitis symptomatica.*

After Sesemann's account of the course of the orbital veins (Archiv f. Anat. u. Phys., 1869, No. 2) we must cease to refer that one of the varieties of neuroretinitis formulated by v. Graefe (Archiv f. Ophth. vii. 2 and xii. 2), called by him "congestion-papilla," to increased intracranial pressure, and thereby induced compression of the ven. ophthalmica. It is much better, after the example of Benedikt (Electrotherapie, p. 253), to consider the circulatory alteration as dependent in most cases upon a disordered innervation of the sympathetic,

caused by the cerebral process, and to seek accordingly to restore the circulatory equilibrium in the brain by galvanization of this nerve. The results which this method has usually accomplished, at least in recent cases, greatly favor Benedikt's theory, and in most cases are recognizable in a few days, both by the ophthalmoscope and by the examination of the central and peripheral visual acuteness. The dizziness also, the headache, the attacks of sudden blindness, and the occasional paralysis of the ocular muscles usually cease, and even the course of the cerebral process—tumor, softening, etc.—appears to be favorably affected by the galvanization of the sympathetic and the lethal termination delayed.

I galvanize the sympathetic daily, either on both sides—since this affection is always bilateral—or on the side which is sensitive under pressure.

I refrain from citing a series of selected cases, but will mention one at present under treatment.

Mrs. Roscher, of this place, 26 years old, somewhat anæmic, was attacked with bilateral neuroretinitis the second time, three weeks ago ; the first attack occurred about a year ago, shortly after a colleague had operated on her for a colossal tumor, during which operation there was severe hemorrhage. Both papillæ were moderately swollen and veiled, veins very full and tortuous, arteries very thin, consequent amblyopia of such a degree that the patient had to be led ; occasionally total blindness, dizziness, headache, anorexia, vomiting, fainting, all as in the first attack ; but no paralysis. Besides repose in a darkened room, the treatment adopted was daily galvanization of the sympathetic nerves, of which the left was particularly sensitive to pressure. To-day, the nineteenth of treatment, the condition is as follows : S = $\frac{2}{3}\%$, with peripheric visual field normal, but with a lack of persistency ;

for although at first No. 20 Snellen could be seen at 20', presently only No. 40 could be recognized; the ophthalmoscope showed no trace of anomaly in either retina or papilla. Treatment now: iron and the constant current.

II.—*In amblyopia without ophthalmoscopical anomaly, as also in amblyopia ex abusu spirituosorum seu nicotini, in amblyopia congenita and amblyopia ex anopsia the results are less encouraging.* Still, I will make further trials. In these cases it would be advisable mostly to use the current through the head as through the optic nerve. I am sorry to say that strychnine injections, with which I experimented long before Nagel's recommendation, have yielded no better results.

III.—*Atrophy of the Optic Nerve.*

Where the atrophy, occasioned by a neuritis descendens, or appearing after a cerebral or medullary disease, has been for a long time stationary, and also where there is absolute amaurosis, I have never accomplished a permanent relief by the constant current. On the contrary, however, in all cases of primary pure atrophy in patients of otherwise good physical and psychical condition, I have undertaken longer courses of galvanism, and it was only in the rarest cases that there was no improvement, while in many it was considerable, and in some astonishing—often in a short time. The treatment consisted in the conduction of the current through the head, especially the direct galvanic excitation of the optic nerve. Notwithstanding Benedikt's repeated arguments, I cannot agree with him in the opinion that the galvanic excitation of the optic

nerve is entirely due to a reflex irritation of the sensitive fibres of the trigeminus, but must rather affirm, with Erb, who has strenuously opposed this theory in behalf of the acoustic nerve (these Archives, II. 1.) with Landsberg (*Arch. f. Ophth.*, XI., 1. p. 69), and others, not only the possibility of a direct irritation of the nerves of special sense, but also the firm conviction that I must ascribe the excellent results which I have obtained in atrophy of the optic nerve solely to the difference of my method of galvanizing from that of Benedikt, viz., to the direct irritation of the optic nerve through the closed lids.

The possibility and probability of an improvement, or at least an inhibition of the process, may be assumed whenever the disease has not yet reached its ultimate condition either by total blindness or long persistency in the same bad state. But, especially where there are spontaneous fluctuations of the visual field and acuteness should the galvanism be continued, even if at first the improvement is scarcely perceptible. The desperate situation of such patients—often still youthful—may encourage the physician in patient effort.

From my pretty extensive observations upon the results of the constant current in atrophy of the optic nerve I will cite but a few cases, the first of which is still under the treatment of one of my colleagues.

Teichmann, teacher, of Zettlitz, in Saxony, came to me first on the 14th of June, 1870. He was a robust, intelligent man of 24 years, and he described to me very minutely the affection from which he had suffered for years. He first sought relief at Leipsic, where, it appears, a good prognosis was made in the beginning. He received a corroborated

tive treatment which was discontinued to allow him to return home and get rid of a tape-worm which had long troubled him. The successful remedy appears to have been of an energetic character, but it exerted no beneficial influence upon the course of the eye disease; on the contrary, sight constantly diminished. In his distress he went to Berlin and sought Prof. v. Graefe, in whose clinic he was treated during six weeks with Heurteloup's leech. Still the sight diminished, and then he fell into the hands of a Berlin homœopathist, P——, who kept him in his institute for some weeks and treated him with injections (?) and consolation—but all to no purpose.

The examination of the patient at his first visit discovered: exquisite atrophy of both optic nerves with shallow excavation of papillæ; veins and especially arteries hair-like and traceable only for a short distance towards the periphery; slight strabismus divergens of left eye with eccentric fixation; continual nystagmus—like movements of both bulbs. With myopic glasses $\frac{1}{24}$ central vision was, in bright daylight, right, fingers at 4', left, only at 3'; peripheric field so contracted that the patient felt as though he looked through a tube; Daltonism. Visual acuity had lately diminished to such a degree that the patient must be led about. As I was at that time experimenting with strychnine injections I subjected this patient to that treatment during three weeks, but with no other result than that he got no worse. Then I commenced with the constant current, and the result was wonderful. On the 27th of July the patient found his way alone. In two months he could count fingers with either eye at 20', fixed centrally with the left alone or with both, and there was no trace of the strabismus. I had a galvanic battery prepared for him, instructed him in its use, and dismissed him with the direction to continue the treatment a year, with intervals. He came to me every two or three months, and each time an improvement was apparent. At the last examination, Nov. 4, 1871, he read Snellen No. 8, and recognized all the colors. The atrophy of the optic has not disappeared, but there is a rosy-red blush over the papilla, and the vessels, especially those on the right side, which were formerly the better, have recovered considerable of their calibre, though still not normal, and are traceable to the periphery. Although it can be hoped only to approximate to the normal visual acuity, I believe that the improvement, though tedious, will continue for a long time.

A second case, which I may cite, is the following:—

Mrs. Harz, from Straken, near Leipzig, 45 years old, received May 23, 1871; suffered a good while from amaurosis of the left eye. Latterly, especially since the care of her sick husband obliged her to be awake much at night, she sees something like a mist before the hitherto sound right eye. The patient is strong and healthy, excepting what a gynecologist of this place pronounces granulations of the mouth of the womb. The ophthalmoscope discovers an exquisite atrophy of the left optic nerve. In the right eye, only the first stage; the papilla somewhat whiter than normal, and the vessels smaller. In an otherwise healthy eye these appearances would perhaps escape special attention, but in view of the circumstances I felt justified in diagnosing atrophía n. optici incipiens. $S = \frac{2}{3} \%$, right peripheric field normal, no color blindness. After three weeks' treatment with galvanism, right $S = \frac{2}{3} \%$, mist cleared away, no suspicious appearance at the fundus, vessels wider, papilla normal coloration. On the left side, finger at 2' above and outwards. She was discharged with instructions to return as soon as any bad symptoms should appear.

Sept. 17. Returned with S . scarcely $\frac{2}{3} \%$, and the mist has reappeared. Twelve days of galvanic treatment effected a cure.

In both the above-mentioned cases nothing but the constant current was used. Only, by way of experiment, a thread seton was put into the temple near the left eye.

The following case shows the effect of the constant current after all ordinary means had been exhausted:—

Mr. Eisenstuck, a very robust septuagenarian, of this place, exhibiting no trace of tabes, blessed with good sleep and appetite and a clear mind, has been for a long time almost blind of the right eye in consequence of sclero-choroiditis posterior with atrophy of the papilla.

April 11, 1871, he came to me on account of defective sight on the left side. Examination: slight swelling of the papilla optici with circumscribed staphyloma posticum, dilatation and tortuosity of the veins,

arteries thin; with myopia $\frac{1}{10}$, $S = \frac{20}{200}$; peripheric field of vision entire, and no color-blindness. Before having recourse to galvanization, trials were made with strychnine injections, sublimate, iodide of potassium, Heurteloup, Turkish and hot sand-baths, but nothing was gained except that the baths appeared to give some comfort. Then from the 1st of June galvanization was applied through the head and locally through the lids. On the 13th of July, 1871, patient was sent out with $S =$ Snellen No. 4, at 6'', and directed to a North Sea bathing place. On his return his condition was the same. On the 20th of October the patient reappeared with sight diminished to Snellen No. 11 at 4''. The ophthalmoscopic examination discovered atrophy of the optic nerve. Galvanization of the eye, and, for experiment, of the left sympathetic nerve. On the 8th of November, after hardly three weeks of treatment, and notwithstanding the atrophy, the patient read Snellen No. 4 at 6''.

The hopelessness of every other kind of treatment in white atrophy of the optic nerve—excepting what may be expected from strychnine—and the effects of the constant current in this disease authorize me to urge further trial. I could add many more cases similar to the above; but I must not neglect to mention that in a number of cases I have made numerous applications without the slightest benefit. The constant current is indeed no sovereign remedy, and so far my utmost endeavors have not enabled me to discriminate at the commencement of treatment those cases which are likely to prove intractable. In spite, then, of some failures, one must not lose patience, but rather persevere; since, with a little practice, the application of the constant current, at least in eye diseases, is easy and does not waste much time.

IV.—*Affections of the Ocular Muscles.*

In regard to the galvanic treatment of paralysis of any or all the motor nerves of the ocular muscles, so exhaustively considered by Benedikt (Elektrotherapie and Archiv f. Ophth. x. 1.) and Erb (these Archives, ii. 2, p. 228), I need only say that my results have been quite as favorable as theirs. But I prefer the direct irritation of the affected parts to the indirect reflex action *via* the trigeminus. For a long time I have used the method of Erb: anode stable on the nucha, or behind the ears, cathode unstable upon the closed lids in the region of the affected muscles. In peripheric paralysis I think we can dispense with galvanization of the sympathetic. But if the paralysis is of central origin, as, for instance, in syphilitic cerebral affections—of which I have lately treated and cured a number of cases, mostly unilateral paresis of the abducens or trochlearis—I lay considerable stress upon this manipulation. Rheumatic paralyses are relieved usually in eight days, often in less time. Less than a week ago, I cured a rheumatic paralysis of the right abducens in a single sitting.

Erb has found that mydriasis with or without coincident paresis of accommodation is very obstinate, but such has not been my experience. I remember only one case, of 20 years' standing, which resisted my persistent galvanic treatment. In mydriasis I apply the anode on the nucha, and with the cathode make circular movements over the closed lids, as advised by Benedikt. Some effect is apparent immediately after the sitting,

diminishes somewhat until the next, but gradually becomes permanent. The cure is often surprisingly quick. In the case of a woman at present under treatment with mydriasis and paralysis of accommodation together with paralysis of the abducens and strabismus convergens paralyticus on the same side, the first-named affection yielded in a few days without calabar, but the paralyzed abducens has not yet recovered.

Hitherto I thought electricity unnecessary in myosis, for in all cases atropine is easier of application and its action is more durable.

Ptosis, without coincident paralysis of other branches of the oculomotorius, resists the galvanic treatment, and in this disorder I have accomplished but little, without being able to give a reason for the failure. Old cases of intermittent blepharospasmus are equally obstinate. Concerning this, Seeligmueller of Halle has published an interesting account in the August number, 1871, of the "*Klinische Monatsblätter.*" In most of the cases I have been able to make some improvement, but it did not last. Thus in the case of a thin old lady with a great number of "pressure points," each application of the cathode to some of the points gave several days' relief, but there appeared at the same time such severe pain in the head that I was obliged to relinquish the galvanic treatment. A subsequent section of the left supra-orbital nerve gave relief for only eight days, although there was complete anæsthesia of that part of the forehead which was supplied by the divided nerve.

I have used galvanism extensively in cases of *insufficiency of the recti interni*, and with brilliant results.

Here I apply the galvanism locally only, at the inner angle. Without relating different cases in detail I will mention that of a gentleman lately discharged from treatment, who had the habit for years of closing the right eye while reading, and who was unable to give an account of the origin of the habit. Some months ago he was attacked with mydriasis and paresis of accommodation in the left eye, for which affection he consulted me. In this case I thought it advisable to have recourse to calabar in order that the patient, who was confidential clerk in an extensive business, might immediately return to his duties. At the same time I proposed galvanism for the insufficiency so long ignored, and, eventually, the quicker to accomplish the purpose, tenotomy of the corresponding externus. After Prof. Coccius of Leipsic, whom he once consulted, had advised him not to be operated on, I continued the galvanic treatment. At the commencement of the treatment the insufficiency was so considerable that a proper convergence for binocular vision at a short distance could be maintained only for a few seconds. The attempt to thus fix the eyes caused such a wide divergence of the mydriatic left eye that a disagreeable strabismus resulted. After about two months of almost daily galvanization, addressed at first to the mydriasis which yielded speedily, the otherwise emmetropic patient could fixate by the hour, and found it necessary only occasionally in the evening to close the right eye. Landsberg (*Arch. f. O.* xi., 1.) is quite as much in favor of galvanism for insufficiency, and he reports minutely a series of cases which I should merely copy were I to relate my own.

V.—There remains to be mentioned an affection, only three cases of which have fallen under my notice, and only the last of which I treated by means of galvanism—*herpes zoster ophthalmicus*. But the effect of the constant current was so brilliant—not especially on the general course of the disease, but upon the accompanying pain—that I do not hesitate to invite further trial. At the last Heidelberg Conference Nagel expressed himself similarly.

VI.—Some time ago the electrolytic action of the constant current was extolled—I do not recollect by whom—in the treatment of *maculæ and leucomata of the cornea*. My numerous experiments with its variously modified use have given no better result than the other methods of treatment—merely negative, and the application is so painful that I have abstained from further attempts. I connected the anode with a probe-pointed sound with which I touched the spots, or penetrated into the leucoma with a gold acupuncture needle which was afterwards charged. Nothing was gained.

I have lately extended my experimentation with the constant current to inflammation of the cornea, especially to phlyctenular form accompanied by considerable photophobia, and I hope to be able soon to report satisfactory results.

CHEMNITZ, November, 1871

ON THE TREATMENT OF ULCUS CORNEÆ SERPENS.

BY DR. NIEDEN,

Assistant Surgeon to the Ophthalmic Institute at Bonn.

Translated by Dr. A. Schapring, of New York.

THE operative treatment of this disease as it has been recommended by Prof. Saemisch in his paper on *Ulcus corneæ serpens*, published at the end of the year 1869, has been largely introduced into practice and has proved successful wherever the execution of the proceeding was confined to characteristic forms, and its details, as given by the author, were strictly adhered to, of which I have satisfied myself both by published and verbal communications. It would seem superfluous, therefore, to speak again of this matter ; I will make a few remarks, however, upon those cases that have since been treated in the clinic of Prof. Saemisch, because this form of disease has been confounded with others, and the operative procedure thus performed where it was not advised.

In the following table only 50 out of 80 cases are recorded, the history of the remainder being incomplete. Three of the latter were so far relieved by the first operation that they discontinued further treatment, and in the other 27 cases the results were corneal specks, but as the notes taken from their history are somewhat defective, no use has been made of them in compiling the following statistics :—

No.	Name.	Sex.	Age.	Eye affected.	Form of Disease. Complications.	Days prev. to treatment.	Etiology.	How often slit. Day when the ulcerative process stopped.	Duration of treatm't. Days.	Papillary margin.	Results.	
1	Seb. Schwalb.....	m.	23 L	Ulc. corn. serp. c. hypopio, 1½ mm. diam		4		2	2	7	free. Nubec. corn. Reads Jacq. No. 2.	
2	Wilt. Faulenbach....	m.	69 R	Ulc. c. c. hyp. Hor. diam. 5 mm.; vert. diam. 4 mm. Total infiltr. Dacryocystobl. Glauco. abs. oc. sin.				*1	3	21	Leucom. adh.	
3	Cath. Dieffenbach...	f.	31 L	Ulc. serp. c. hyp. Diam. 1½ mm.		8	Trauma.	9	2	15	free. Nubec. corn.	
4	Ad. Fallenbach.....	m.	36 R	Ulc. c. c. hyp. Infiltr. corn. Sten. duct. naso-lachrym. Pannus trach., ...				4	2	14	free. Mac. corn.	
5	Jacob Eltzer.....	m.	50 L	Ulc. serp. c. hyp. Diam. 3 mm.		14	Trauma.	12	3	30	free. Mac. Hor. diam. 3 mm.; vert. 2½ mm. Reads Jacq. No. 5.	
6	J. Darkew.....	m.	42 L	Ulc. corn. c. hyp. Diam. 4 mm. Infiltr. tot.		5	Trauma.	10	2	14	Leuc. adh. S = ½.	
7	C. Bollig.....	f.	37 L	Ulc. serp. c. hyp. Diam. 5 mm. Iritis serosa and Phthisis b. d.		5		14	3	27	free. Mac. Reads J. No. 7.	
8	W. Schmitz.....	m.	44 R	Ulc. serp. without hyp. Diam. 4½ mm.		8	Trauma.	6	2	33	free. Mac. J. No. 8.	
9	G. Schmidt.....	m.	33 R	Ulc. serp. c. hyp. Diam. 4 mm.		2	Trauma.	7	2	30	free. Mac. J. No. 9.	
10	M. Stürzel.....	f.	65 L	Ulc. c. c. hyp. Inf. Phthisis bulbi dextr.				5	2	20	free. Mac. Horiz. diam. ⅞''', vert. 1½'''. Counts fingers at 5.6.	
11	Hubert Eppenstein..	m.	26 L	Ulc. serp. c. hyp. Blepharitis ciliaris.				6	2	12	free. Mac.	
12	J. Jungblicher.....	f.	68 L	Ulc. serp. c. hyp. Dacryocystobl. Phthisis bulbi dextr.		14		4	2	21	Leuc. adh.	
13	Caec. Fuchs.....	f.	60 L	Ulc. serp. without hyp. Diam. 3 mm.			8	Trauma.	7	2	23	free. Mac.
14	Jacob Müller.....	m.	62 R	Ulc. serp. without hyp. Diam. 5½ mm.				5	2	+		

* Aqueous humor escaped spontaneously afterwards.

† Discontinued treatment. Prognosis. Good.

No.	Name.	Sex.	Age.	Eye affected.	Form of Disease. Complications.	Days prev. to treatment.	Etiology.	How often slit.	Day when the ulcerative process stopped.	Duration of treatment. — Days.	Results.	
											Pupillary margin.	
15	Joh. Rechfeld.....	m.	78	R	Ulc. serp. c. hyp.....	14		7	2	23	free.	Mac.
16	A. Graw.....	f.	33	R	Ulc. corn. c. hyp. Hor. diam. 7 mm., vert. d. 4 mm. Tot. infiltr.	14		6	+			
17	El. Heinen.....	f.	68	L	Ulc. serp. c. hyp.....		Trauma.	9	2	26	free.	Mac. Counts fingers at 12'.
18	J. Buchholz.....	m.	39	L	Ulc. corn. c. hyp. Diam. 5½ mm. Infiltr.....	30		12	2	32		Leuc. ath.
19	T. Schneider.....	f.	46	L	Ulc. serp. c. hyp. Phthisis bulbi dextri.....	7		7	2	42	free.	Mac. Diam. 4½ mm. J. No. 9, sten. No. 2.
20	Joh. Bungs.....	m.	38	R	Ulc. serp. without hyp. Diam. 5 mm.....	7	Trauma.	15	2	27	free.	Nubec. J. No. 5.
21	Marg. Stoll.....	f.	52	L	Ulc. serp. without hyp. Diam. 5¼ mm. Dacryocystol.....			9	2	26	free.	Mac.
22	Anna Schneider.....	f.	66	L	Ulc. serp. c. hyp. Hor. diam. 4½ mm., vert. d. 5½ mm. Sten. duct. nasol.....	8		2	2	26	free.	Mac.
23	Franz Kitz.....	m.	48	R	Ulc. corn. c. hyp. Diam. 6¼ mm. Total infiltr. Phth. bulb. d.....	14		20		§		Leuc. ath.
24	Ursul. Münich.....	f.	65	R	Ulc. serp. c. hyp. Diam. 5 mm. Chron. conj. catarrh.....	8	Trauma.	2	2	15		
25	M. Scharf.....	m.	55	L	Ulc. serp. c. hyp. 3½ mm. Hor. diam. 1½ mm.....	14	Trauma.	5	2	30	free.	Mac. Vert. diam. 3 mm. J. No. 3.
26	M. Schmitz.....	f.	43	L	Ulc. serp. c. hyp. Diam. 5 mm. Dacryocystol.....	14		2	2	30	free.	Mac.
27	Ch. Velen.....	f.	61	L	Ulc. corn. c. hyp. Diam. 6 mm.....	14		9	2	26	free.	Mac.
28	W. Jung.....	m.	59	L	Ulc. corn. c. hyp. Diam. 4 mm. Parac. without success. Infiltr.	14		5	2	18	free.	Mac.
29	Carl Maurer.....	m.	48	R	Ulc. c. c. hyp. Infiltr. Hor. diam. 7 mm., vert. d. 5 mm.....	14		2	2	28		Leuc. ath.

Of the cases recorded, there occurred in the age between $\frac{70-80}{2}$, $\frac{60-70}{10}$, $\frac{50-60}{11}$, $\frac{40-50}{13}$, $\frac{30-40}{9}$, $\frac{20-30}{3}$, and between $\frac{10-20}{2}$ cases. The largest number in proportion to the number of living individuals were between the ages of 60-70.

As to the sex of the patients, 27 out of 50 were males, 23 females, the latter being only 8 per cent less. This ratio might well have been anticipated, since the females of the poorer class are nearly as much exposed to injuries that give rise to a great number of these ulcers as the males. An injury was the origin of this disease in 19 cases, or 38 per cent. ; there was usually a bruise of the cornea, or an irritation caused by a foreign body lodged for some time in the conjunctival cul-de-sac, and which rubbed against the cornea.

Since, in the majority of cases, statistics show that the left eye is injured, it would seem strange that we found the right eye as often diseased as the left. This apparent disproportion is explained by the fact that dacryocysto-blennorrhœa and stenosis of the lachrymal duct establish a predisposition to the formation of suppurative corneal ulcers, as is here shown in 15 cases, that is, in 30 per cent. where the right side was affected in 9 cases, the left only in 6. Whereas a greater number of ulcers produced by injuries occurred in men, complications, with diseases of the lachrymal duct, were more frequent in women—in the ratio 9 : 6, that is, 18 per cent. : 12 per cent.

It is remarkable that in 9 cases, or 18 per cent, the other eyeball was found to be shrunken, the result, as it was stated, of a similar ulcer. This seems to prove that these ulcers not only attack eyes during senile met

amorphosis, but generally such as offer the least resistance to injurious influences.

The ulcers occupied, without exception, the centre of the cornea, none being found at the periphery. Abscesses, inflammatory and torpid infiltrations of the cornea, were excluded, as already stated. However, only in 36 cases, or 72 per cent., characteristic serpent ulcers were found, viz—a grayish opacity, situated in the superficial or deeper layers of the cornea, according to the stage at which the process had arrived, in which there was a loss of substance; the base of the latter uneven, and covered with particles of sloughed tissue. The region of proliferation was white, semi-circular, and prominent; sometimes there was a furrow throughout its whole length, and in some cases it was divided into 3-4 semi-circular mounds. This was often surrounded by an infiltrated zone which, in its immediate vicinity, appeared as a striated opacity, whereas at some distance there was a more or less dense infiltration; in the first stage, the region of proliferation may be sharply defined from the normal corneal tissue. In three-fourths of the cases, ciliary neuralgia and symptoms of general irritation were present. Hypopyon is not a characteristic feature of the process, since it was missing in 8 cases, or 16 per cent., whereas irritation of the iris could be demonstrated in every case.

In two cases, that is, in 4 per cent., marked iridocyclitis was present. In 14 cases, or 28 per cent., when they came under observation, the ulcerative process was so far advanced that only a few, or even none, of the characteristic features of *ulcus corneæ serpens* were left,

as, owing to the large extent of destruction of tissue, the white mound of proliferation could no longer be traced, the grayish tint of the base was converted into yellowish white, and the ulcer had penetrated deeply into the corneal tissue ; in almost all these cases there was iridocyclitis. This form has been termed *ulcus corneæ c. hypopyo et infiltrat.*

Out of these 50 cases, there were 28 per cent. ulcers with diffuse infiltration ; 72 per cent. *ulcera serpentina* ; 56 per cent. *ulcera serpentina c. hypopyo* ; 16 per cent. *ulcera serpentina* without hypopyon.

Treatment.—As soon as it was ascertained, either immediately or after one day's observation, that the ulcerative process was still progressing, the whole base of the ulcer was slit in the following manner—no chloroform being administered :—The eyeball being steadied by the fixation-forceps, Graefe's knife was thrust into the anterior chamber through the healthy tissue of the cornea, on one side, near to the edge of the ulcer, and carried so far as its opposite edge, the counterpuncture being made in the normal tissue too. The fixation-forceps being taken away, the base of the ulcer was slit by gentle to-and-fro movements of the knife, the edge being directed straight forward.

The cut was always performed in such a way that it divided the edge of proliferation in its middle, or at least one segment of it. The aqueous humor escaped slowly from the puncture and counterpuncture, the hypopyon mingling with the last drops. The rest of the hypopyon, if any remained, was left, except when it consisted of fibrinous coagulations which protruded into

the wound, in which case they were removed by a pair of forceps. If the coagulations did not protrude, no effort was made to coax them out by gently rubbing the lids, but they were left in the anterior chamber to undergo absorption. Only in cases where the ulcer occupied a considerable part of the cornea, the cut was modified in such a way that only one end lay in normal tissue at some distance from the actual or the supposed place of the edge of infiltration, while the other end was located in the middle or more toward the margin of the ulcer, according to its dimensions.

Twice there occurred a sudden evacuation of the anterior chamber, yet no bad effects were noticed afterwards. Indeed, no untoward event occurred, even with unruly patients, and no evil consequences were observed. Most of the patients described the pain caused by the operation as rather trifling.

An hour after the operation, atropine was instilled, this being repeated 4-8 times a day, the patients being kept in bed on their back. Sometimes a light protective bandage was applied, but no compressive bandage. As long as the ulcer showed any tendency to progress, the cut was re-opened every day by Graefe's knife, sometimes by Weber's canaliculus knife, without fixing the eyeball, the patient lying on his back, the lids being kept apart by the fingers of an assistant. As to the time when the continuance of this treatment is no longer useful, no other indications were found than those given by Saemisch in the paper already referred to, viz.: the total disappearance of the zone of infiltration, the base of the ulcer being sharply defined, the mound

of the proliferating tissue having sunk to a level of the surface of the ulcer, a uniform grayish hue of the wound and of the base of the ulcer, the latter clearing up and all the symptoms of irritation of the eye having subsided. No general rule can be laid down as to the time when these symptoms make their appearance; however, later observations made in this clinic and that of Wiesbaden have shown, that it is commonly less than three weeks, which was said to be the average time in Saemisch's paper.

The average number of slittings performed was 6.4, as shows the following statement :

In 3 cases or 6 per cent. slitting was performed once,

“ 6 “ “ 12 “ “ twice,

“ 4 “ “ 8 “ “ 4 times,

“ 8 “ “ 16 “ “ 5 “

“ 5 “ “ 10 “ “ 6 “

“ 5 “ “ 10 “ “ 7 “

“ 1 “ “ 2 “ “ 8 “

“ 4 “ “ 8 “ “ 9 “

“ 2 “ “ 4 “ “ 10 “

“ 2 “ “ 4 “ “ 12 “

“ 1 “ “ 2 “ “ 14 “

“ 2 “ “ 4 “ “ 15 “

“ 1 “ “ 2 “ “ 20 “

In three cases the slitting of the ulcer was performed only once, the wound not closing afterward. In these cases the ulcer was combined with a diffuse infiltration of the cornea, one half or even three-fourths of the cornea having been destroyed, and the wound was necessarily very large. In six cases, the process was

completely arrested 36 hours after the first operation. In 8 cases, the largest number in the above statement, the ulcer was slit 5 times, this coming very near the average figure, which is 6,4.

Though it might have been anticipated that in old age the reparation of the ulcer, like all other vital processes, would go on very slowly, nevertheless, the cases occurring between the ages of 30 and 40 required the longest treatment, as shown by the following table. It shows the ratio of cases and slittings performed, the number of cases occurring between the ages of 70-80 as well as that of the slittings performed upon them, each being put = 1.

Age.	Cases	Slittings.	Age.	Cases	Slittings.
70-80....	1,0	1,0	30-40....	4,5	7,8
60-70....	5,0	4,8	20-30....	1,5	1,8
50-60....	5,5	6,7	10-20....	1,0	1,7
40-50....	6,5	7,9			

Old age and the period of the most active development show here a remarkable coincidence.

More than one slitting was never done in one day. It was never necessary to make a crucial incision. In two cases the re-appearance of the ulcerative process made it necessary to slit a second time after the re-opening of the wound had been discontinued for some time.

The *results obtained* by this treatment as shown by our statement, may serve well to corroborate the observations published two years ago, that by this treatment the progress of the disease is immediately arrested,

and as much sight is preserved as is possible under those circumstances, and that the ciliary neuralgia ceases a short time after the commencement of the treatment, which, on an average, does not last longer than four to five weeks.

Our statement contains, however, two cases which were treated by this method without success. But these are exactly the same cases in which the ulceration was the most advanced ; in one case the horizontal diameter extending to 7 mm., the vertical to 4 mm. ; in the other case, having a diameter of $6\frac{1}{2}$ mm., and the remainder of the corneal tissue which was not yet occupied by the ulcer being already infiltrated. The slitting was made here only as a trial, and the prognosis was considered as exceedingly bad from the beginning. In one case the result was phthisis anterior, the formation of a staphyloma being prevented ; in the other, in which warm fomentations were made, the result was an extensive leucoma adhærens.

On the other hand, in 42 cases or 84 per cent. the progress of the ulceration was arrested by the first slitting, the same result being obtained in 6 cases or 12 per cent. by the second slitting ; the ciliary neuralgia which was more or less severe, ceased at the same time in all these cases. The apprehension of the formation of anterior synachiæ which was formerly feared, was verified in those cases only in which the ulcerative process had extended so far that there was no hope for a cure without leucoma. In 70 per cent. the pupillary margin was absolutely free when the treatment was stopped.

The duration of treatment varied with circumstances so that an average time can scarcely be found. But in the main, patients could be dismissed from the hospital at the beginning of the fourth week, either cured entirely, or continuing treatment as out-door patients.

The results obtained are the following :—

In 2 cases or 4 per cent. failures.

" 2	" 4	"	treatment discontinued.
" 11	" 22	"	leucoma adh.
" 35	" 70	"	nubeculæ or maculæ corn.

RESULTS CLASSIFIED

1) According to the age of the patients :—

Age.	Mac. per cent.	Leuc. per cent.	Failures. per cent.	Treatm. discon. per cent.
70—80	4	—	—	—
60—70	10	6	—	4
50—60	16	6	—	—
40—50	18	6	2	—
30—40	12	4	2	—
20—30	6	—	—	—
10—20	4	—	—	—

2) According to the form of the ulcer :—

a) of 28 per cent. diff. infil.	b) of 56 per cent. ulc. serp. c. hyp.
16 per cent. leuc. adh.	50 per cent. mac.
4 " failures.	6 " leuc. adh.
8 " mac.	

c) of 16 per cent. ulc. serp. without hyp.

12 per cent. mac.

4 " treatment discontinued.

3) According to the sequels and complications :—

a) out of 70 per cent. nubec. corneæ there were

8 per cent. diff. infiltr.

12 “ ulc. serp. without hyp.

16 “ ulc. s. c. hyp. et dacryocystobl.

34 “ ulc. s. c. hyp. without complic.

b) The 4 per cent. failures were all ulcers with diffuse infiltration.

c) In 4 per cent. the treatment was discontinued, but the prognosis was good.

d) out of 22 per cent. leuc. adh. there were

8 per cent. total infiltr. without compl.

8 “ tot. inf. and dacryocystobl.

6 “ ulc. s. and dacryocystobl.

If we compare these results with those obtained at the clinic of Zurich (M. Bukowa: Zur Hypopyonkeratitis. Diss. inaug. 1871), where the ulcer was sometimes treated by iridectomy, sometimes by slitting, but the latter with less satisfactory results, the treatment as it is pursued here appears to be far more advantageous :—

	Iridectomy, Zurich.		Slitting, Bonn.		Slitting, Zurich.	
Phthisis bulbi.....	11.5	per cent. . .	4	per cent. . .	14.2	per cent.
Leuc. adh.....	24.6	“ ..	22	“ ..	40.5	“
Mac.....	57.4	“ ..	70	“ ..	45.3	“
Treatment discontinued	6.5	“ ..	4	“ ..	—	

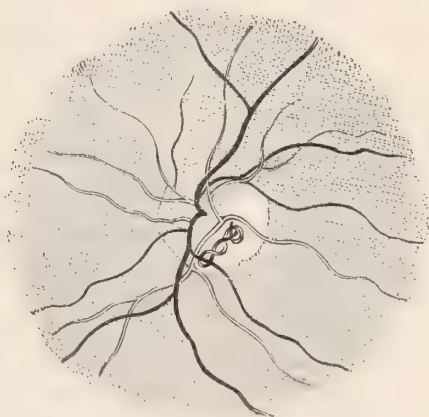
BONN, December 18, 1871.

A CASE OF A PERSISTENT REMNANT OF THE HYALOID ARTERY.

BY DR. A. SCHAPRINGER, OF NEW YORK.

CHARLES S——, æt. 11 years, suffers from asthenopia. Being examined with glasses, both eyes show hyperopic astigmatism = $\frac{1}{40}$, which being corrected, S proves to be = $\frac{2}{20}$.

On ophthalmoscopic examination, no abnormality can be found in the fundus of the left eye.



(ERECT IMAGE.)

In the right, a vascular loop, taking its origin near the centre of the optic disc, projects into the vitreous

in a direction forward and slightly downward. Its two branches, having the calibre of a main branch of the central retinal artery, emerge separately from the area of the disk, and are twisted round each other. Those portions of the loop, especially its apex, which cross the visual line of the observer at angles of about ninety degrees, appear bright red like the retinal arteries, while the other portions have a dark red color. The loop sends off no branches, and seems to occupy a firm position in the vitreous, as movements of the eyeball do not make it float.

With relaxed accommodation, the origin of the loop can be distinctly seen by an emmetropic observer with -24 , its apex with $+8$, the real length of the loop, according to Knapp's table, (these Archives, Vol. ii., p. 397,) is therefore 1, 8 mm.

This case resembles closely that described by Dr. Charles J. Kipp in the present number of these Archives.*

The following extract from Von Ammon's paper on the Development of the Human Eye† refers to a loop of the *arteria hyaloidea s. centralis foetalis* :—

“I call *ansa foetalis arteriæ centralis* a loop which the central artery shows sometimes in its course through the *canalis hyaloideus*, before reaching the posterior wall of the lens-capsule . . . It . . . disappears gradually as the eye is growing in length, and has, perhaps, some relation to the subsequent atrophy of the artery. Here, too, much is left for further investigation.”

* Clinical observations by Charles J. Kipp.

† Graefe's Arch. f. Opth., vol. iv., part 1, p. 221.

Whether the anomaly above described has any relation to this *ansa fetalis arteriæ centralis* of Von Ammon, I do not know. So much, however, seems certain, that it is not a new-formed blood-vessel, but a remnant of the hyaloid artery.

A METHOD OF OPERATING FOR THE CLEFT LOBULE OF THE EAR.

By H. KNAPP.

IN this country, where the women of all races wear ear-rings with more or less voluminous appendages, we are not infrequently called upon to unite fissures in the lobule. The text-books saying nothing about the removal of this little deformity, I presume that the simple union of the slit by a few sutures, after its edges have been freshened, is thought so natural a procedure as to require no special description. Yet its results, in a cosmetic point of view—which alone comes into question—may be rendered more satisfactory by the introduction of a little improvement in the operation. This improvement I borrow from the modern (*Mirault-Langenbeck*) operation for hare-lip. To avoid repetitions I shall describe the method from beginning to end.

If you have to operate on the left ear, let your patient recline to the right side, you stand behind his back, an assistant with his thumb and index finger seizes and stretches the anterior part of the cleft lobule, while you extend the posterior part, then thrust a Graefe's cataract knife or any narrow-bladed scalpel through the anterior part, near the lower end of the slit,

(at *a*, accompanying figure), sever a thin slice of skin along its edge; when arrived near the other end of the slit (at *c*), make the slice a little broader, leave its end (at *b*) in connection with the auricle, then turn the knife, go backward about two lines, and there cut across the detached slice (at *c*), thus forming a small flap. Now seize the long portion of the slice with a pair of forceps, and divide with the knife its other end (at *a*) by a slightly curved section. Without waiting long for the cessation of the bleeding, you may unite the edges of the wound



by three interrupted sutures. The first is applied to the middle of the anterior edges (indicated by two points in the drawing), the second, about opposite the first, to the posterior edges. The curved needles need not penetrate more deeply into the substance of the lobule than about one third of its thickness. By the

third suture the small flap (*cb*), left at the posterior part of the lobule, is made to bridge over the lower extremity of the gap. The needle, therefore, is first thrust through the free end (*c*) of the little flap, and then through the lower edge of the wound in the anterior portion of the lobule, the suture tied,—and the operation is finished. No dressing is required. In three days the sutures are removed. In every case thus operated on, have I obtained immediate union.

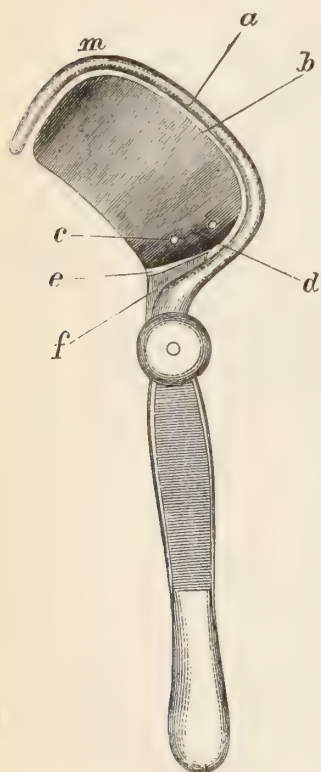
The procedure just described has the advantage that, by the adaptation of the little flap to the lower extremity of the wound, it restores the natural curved outline of the lobule, whereas operations without the formation of a flap, leave a notch.

AN IMPROVED LID-FORCEPS, ESPECIALLY FOR THE OPERATION OF ENTROPIUM.

By H. KNAPP.

THE clamp-forceps which Dr. L. A. DESMARRES (father) invented and described in his text-book (2d Ed. 1854, tome I., p. 602) under the name of *pince-anneau* or *pince fenêtré pour l'extraction des kystes des paupières*, is a most convenient instrument for the removal of all kinds of tumors in the eye-lids. SNELLEN modified it by leaving off that part of the ring which corresponded to the free margin of the lid, and thus made it applicable to operations involving the palpebral edge,—for instance, the operations for distichiasis, trichiasis, and entropium. Snellen's modification may be still further improved by letting the ring *surround* the margin of the plate, instead of resting upon it. This idea suggested itself to me on observing that in the greater number of cases of entropium, the half ring of the clamp does not enclose all that part of the inverted lid on which we have to operate. If, in such cases, we employ Snellen's clamp at all, we can excise only a central portion of integument, muscle, and cartilage, then we have to remove the instrument in order to extend the wound toward the angles. Under those circumstances it is more expeditious to dispense with the clamp altogether, and use the old horn-plate from the beginning to the end of the operation. This defect of the clamp can be obviated by making the half-ring larger than the plate, so that, when the instrument is closed, the ring not only

surrounds the plate, but leaves a free space of about a millimetre in breadth between its inner margin (See *a*. in figure) and the border of the plate (*b*). Messrs. Pfarre and Stohlmann, of the firm Tieman & Co., New



York, have made such an instrument for me very neatly, which the accompanying full-sized cut represents. The plate is curved as in Snellen's modification, but instead of being iron, it is of tortoise shell, which does not give the patient a sensation of cold, nor dulls the edge of the knife in case the lid be pierced, as a metal plate would. It is fastened by two rivets (*c*) to the bevelled end (*d*) of the lower branch of the forceps, which is wedged into the edge of the tortoise-shell plate. The upper surface of this edge (*e*) projects over the handle of the lower branch in such

manner that, when the forceps are closed by the screw, the upper surface of the plate is on a level with the half-ring.

This instrument is more serviceable than either Desmarres' or Snellen's. Its plate may be as long as the palpebral fissure. If a tumor is to be extirpated, only

the anterior rounded angle of the instrument (near *m*) need be passed under the lid, but in cases of larger tumors or ectropium the whole plate is inserted between the eye-ball and the lid. When the half-ring is screwed down, the whole lid is extended and projects over the ring, thus facilitating the removal both of tumors and of integral parts of the lid. If the palpebral fissure be shortened, as in the majority of cases of entropium, the outer commissure should be divided previous to the insertion of the clamp. A piece of skin and muscle can then be easily removed from the whole length of the lid. The entire tarsal cartilage thus is not only laid bare, but rendered tight and prominent. Its grooving which is difficult and mostly unsatisfactory if done with the point of the knife, can now be accomplished readily and neatly by passing the whole cutting edge of a straight scalpel—which should be very sharp—along the convex surface of the cartilage from one side to the other. Thus it is as easy cleanly to excise a wedge-shaped slice from its outer layers as to remove the cartilage in toto or in portions of any size and shape. Hemorrhage is easily and completely arrested with the new instrument, which *bends and compresses* the lid between its ring and plate, whereas the old instrument acts by simple pressure. This improved clamp forceps may remain in position till the sutures are applied, and the whole operation is terminated. With its assistance operations for entropium can be very quickly performed.

Like Snellen's clamp, the one above described can be used on one eye only. Lately I had another made, which is *applicable to both eyes*. It differs from the

former only in the direction of the handle, which is straighter downward, that is, forming an angle of about ninety degrees with the lower margin of the plate. The handle lies parallel with the nose, and neither it nor the screw is in the operator's way.—The modification of the clamp-forceps of Dr. J. S. PROUT, of Brooklyn, can be so changed that the half-ring will be larger than the plate. In Prout's lid-forceps, the branch with the half-ring turns on a horizontal axis at its lower end so that the ring may apply to either side of the tortoise-shell plate. The closure is effected by a double-headed pin, sliding along a slit-like opening in each branch of the forceps. The instrument is thus made applicable to both eyes; but the plain surfaces of its plate, and the want of a nice graduation of the pressure exerted by its closure, render it inferior to Snellen's forceps.

Messrs. Tiemann & Co., New York, make all the varieties of lid-forceps here mentioned. The instrument above described, consisting in having the half-ring larger and on a level with—not upon—the plate, may claim over the lid-clamps heretofore in use the following advantages:—

1. It controls hemorrhage more thoroughly.
2. It gives a larger space on which to operate.
3. It extends the parts to be removed, and renders them prominent and better exposed.

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OPHTHALMOSCOPIC OPTOMETRY, AND DESCRIPTION OF A NEW OPHTHAL- MOSCOPE.

By H. KNAPP.

MOST of the recent improvements in the construction of ophthalmoscopes have for their object a convenient arrangement of an increased number of auxiliary or correcting lenses. Such lenses are indispensable to the examination in the erect image, and useful to the examination in the inverted image. In addition to that, they enable us to determine the anomalies of refraction independently of the answers of the patients, many of whom are unable to make any answers at all. The use of the auxiliary glasses being so important and varied, it is easily understood what gain in accuracy and time will be derived from their appropriate and convenient arrangement. The simple concave mirror is now almost generally adopted. By various contrivances auxiliary lenses were added to it: Liebreich connected with it a fork-like holder, into which small lenses could be inserted. He limited the number of auxiliary lenses to five. As the want of an increased number was soon felt, I had, about ten years ago, a complete trial case of small spectacle glasses made, which were inserted into Liebreich's holder whenever I wanted to determine errors of refraction with the ophthalmoscope, or examine ametropic people in the upright image. This

answered all purposes, but was tiresome work and added to the expense of the ophthalmoscope the much greater expense of a complete set of trial glasses. To avoid this, H. D. Noyes enlarged the holder behind the mirror so as to fit the glasses of the ordinary trial cases of Paetz and Flohr, or Nacet, but he sacrificed the neatness which rendered the small Liebreich ophthalmoscope so handy.

Another arrangement, introduced by REKOSS of Königsberg, and frequently used, is a rotating disk behind the mirror. In its ordinary form it admits of a small number of glasses only, and becomes unwieldy if a greater number is inserted, as is the case with the ophthalmoscope of H. COHN of Breslau, the disk of which is 3 inches in diameter. When the disk is fastened in the centre on a pivot, it soon becomes loose and thereby inconvenient. The best application of Rekoss' disk was made, 4 years ago, by E. G. LORING of New York. He placed 23 glasses, half positive and half negative, into three separate disks, which could one after the other be inserted into a ring behind the mirror. By lateral springs, connected with the ring and pressing upon the border of the disks, the disks are held in their places, and can be easily turned.

The workmanship of the optician, H. W. HUNTER, of New York, deserves all praise. The instrument which I had in daily use these four years has never been repaired, and is still in perfect condition. Loring's mirror has a sufficient number of glasses for nearly all practical purposes, namely: + 3, 4, 5, 6, 7, 8, 10, 12, 16, 24, 48, and - 2, 3, 4, 5, 6, 7, 8, 10, 12, 16, 24, 48.

One aperture in one disk remains empty. This arrangement reduces the mechanical labor required in an ophthalmoscopic examination to the alternate insertion of three disks, and to the passage from one lens to another by turning the disks.

The examination with the ophthalmoscope is of such paramount importance to the eye surgeon, that he should have all possible conveniences to do it efficiently, comfortably, and expeditiously. I examine nearly all my patients with the ophthalmoscope, even if there be no suspicion of an intra-ocular difficulty. It gives me more certainty of diagnosis, and the patient the satisfaction of receiving careful attention. In order to do this with the least inconvenience and in the shortest time, I have my ophthalmoscope room adjoining the consultation room, and provided with an Argand gas burner mounted on a bracket movable in all directions. Thus, patients may be examined either standing or sitting. Standing saves a good deal of time. In the examination in the upright image, the physician should look with his right eye into the right eye of the patient, and with his left eye into the patient's left, at a distance which need never be greater than one inch and a half to two inches. To do this, we must either change the position of the lamp (which is commonly inconvenient), or take the patient to the other side, which is more easily done in standing than in sitting.

I rarely finish an ophthalmoscopic examination without determining the state of refraction of the eye. This can be readily done with Loring's mirror for emmetropic and moderately hyperopic patients; but when there is no hyperopia and we wish to determine whether there is myopia, and of what degree, we have to insert another disk, and when the degree of myopia or hyperopia is considerable, we must change the disk again. The same process has to be gone through when exudations or depressions render the relief of the background of the eye

irregular, provided we care to know the amount of such elevations and depressions. As all this consumes time; we are apt to omit, in many a case, an exceedingly important mode of investigation, contenting ourselves with the examination in the inverted image, just as we are liable to omit, in many a case, the examination with the ophthalmoscope altogether when we have no more convenient accommodations for it than the darkening of the consultation room by closing shutters or curtains. These requirements of the daily practice led me to the construction of an ophthalmoscope with which a complete set of auxiliary lenses is in constant connection, without detriment to the neatness and convenience of the instrument. Its reflector is the ordinary concave mirror, as in Liebreich's, Loring's, and other instruments. It is screwed on a thin, plain plate of metal. (See Fig. 1.) On the other side of this metal plate lie two disks (Fig. 2. A), of which the upper contains the convex lenses, 2, 3, 4, 6, 8, 10, 12, 14, 17, 20, 24, 33, 48, and the lower a like series of concave lenses.

The accompanying figures are taken from the first copies of the instrument, which I exhibited at the meeting of the American Ophthalmological Society in July, 1873. In these first instruments the series of lenses began with No. 3, instead of No. 2.

Each disk rotates on a central pivot, and presses upon a delicate spring, having at its end a small point-like elevation. Opposite each lens is a point-like depression, into which the point of the spring falls when the disk is rotated. These depressions are not so deep, however, as to prevent the disk from being easily turned,

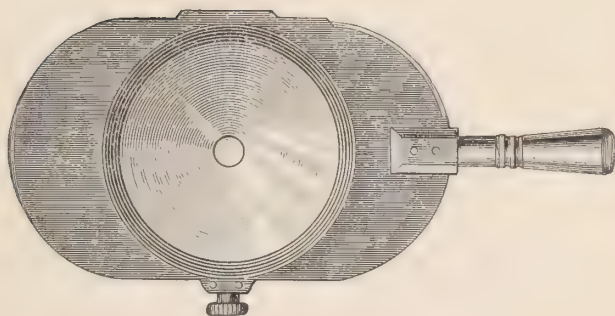


Fig. 1.

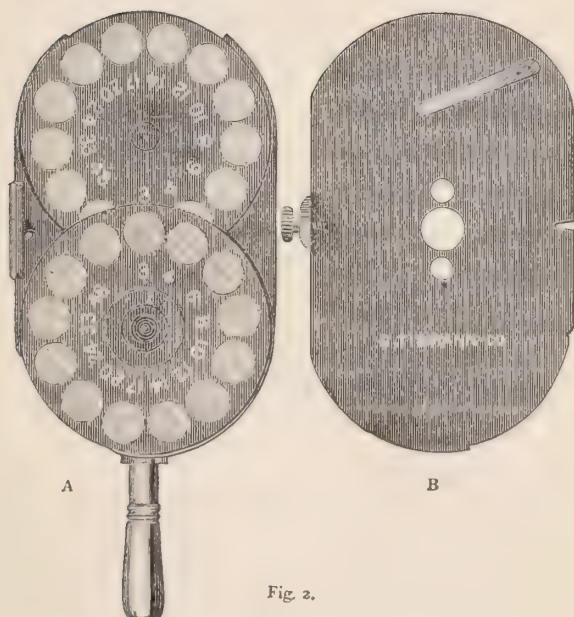


Fig. 2.

yet deep enough to cause the arrest of the disk, when the centre of the auxiliary lens through which we want to look is just opposite the centre of the aperture in the mirror. The disks are held in position and covered by a thin removable metal plate (cover), on the anterior (looking toward the patient) surface of which is a delicate straight spring (Fig. 2. B) which presses upon the upper disk, whereas the lower disk is steadied by a spiral spring in the centre of its posterior surface (Fig. 2. A). On one side of the metal cover (Fig. 2. B) is a notch fitting over a point on the other side of the body of the instrument, whereas on the opposite edge of the notch is a small perforated projection through which passes a thumb-screw, fastening the cover to the body (Fig. 3) opposite the aperture in the mirror.

The margin of the lower disk overlaps the margin of the upper (Fig. 2) in such a way that each positive glass can be covered by each negative glass, and the inverse. Thus combinations are formed which enable us to obtain a very extensive series of test-glasses.

The rotation of the disks is exceedingly easy. When the instrument is closed (Fig. 3), the margin of the upper disk projects over the upper edge of the metal plates, whereas the margin of the lower disk projects on both sides over the lower end of the plates. Each disk can be rotated to the right or left by a slight touch of the finger. This arrangement enables us to *change the glasses without removing the instrument from the eye*. The lower disk is rotated with the forefinger of the hand which holds the instrument, whereas the upper disk is turned with the forefinger of the other hand.

The cover has three round apertures (Fig. 3). The larger, central one is opposite the aperture in the reflector, and serves for the passage of the rays of light from the eye examined into that of the physician. The correcting lenses, when used, lie between this central aperture of the cover and the aperture of the reflector.

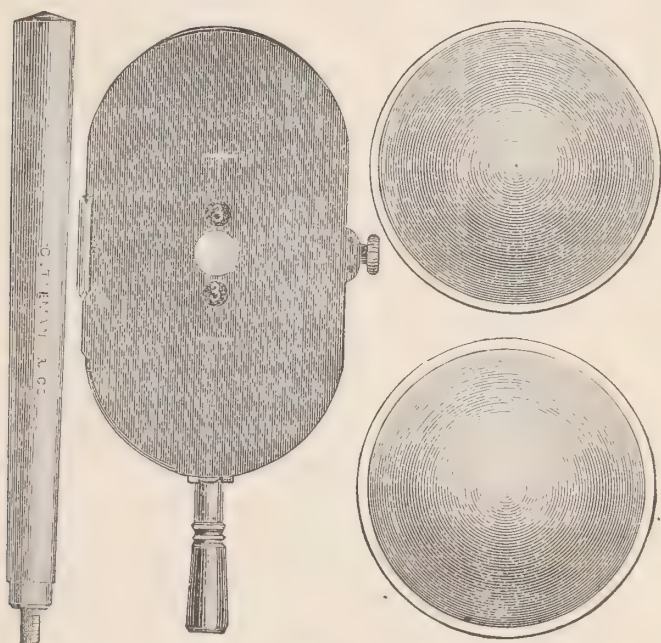


Fig. 3.

A

In order to know what lenses are used, two smaller round openings are placed the one above and the other below the central aperture in the cover. Through these smaller apertures we read the numbers of the auxiliary lenses which are behind the opening in the mirror. Whether these lenses are positive or negative, is indicated by the + and - signs placed near the

smaller apertures (Fig. 3). *The cover prevents the auxiliary glasses from being easily soiled.* If, after prolonged use of the instrument, dust collects on the lenses, the cover can be removed, the disks taken out and cleansed. This cleansing is very simple, and rarely needed, as a little dust does not materially interfere with the purity of the ophthalmoscopic image.

A short ivory handle (Fig. 3) screws into a brass socket fastened to the mirror, and two larger lenses (+ 2 and + 3 or other numbers, according to the pleasure of the physician) are added (Fig. 3. A). The parts of this ophthalmoscope are represented by the accompanying figures in their natural sizes. The whole instrument is contained in a case a little larger than half the size of Fig. 3, viz., 3'' 9''' in length, 2'' 7''' in width, and 11''' in thickness. The workmanship of the instrument (by Miller Bros., 1223 Broadway, New York) is of a high order as to neatness, accuracy, and durability. With the handle, the instrument weighs two ounces, and its greatest thickness from the rim of the reflector to the back surface of the cover is five millimetres (two-eighths of an inch). Its price is \$40.

As to the *use* of the instrument I need say but little. Every one who knows ophthalmoscopy can use the instrument and will be familiar with it in a few days. The rotations may be to the right or to the left, till the number of the desired glass shows in the small aperture. Commonly the examination is begun without any auxiliary glass, namely for the investigation of the refracting media. After that, the fundus is explored in the inverted image. Near-sighted observers do this

without an auxiliary glass, but emmetropic, presbyopic, and hyperopic observers are in the best optical conditions by placing a convex glass behind the mirror, thus rendering themselves artificially myopic, which should be of the degree of about $\frac{1}{10}$ or $\frac{1}{8}$ the ordinary visual distance for looking at fine objects. The advantages of placing a convex glass behind the mirror are as follows : 1, the observer, being able to go nearer to the examined eye, sees the image in a greater intensity of illumination ; 2, he can relax his accommodation ; 3, he sees the image enlarged by the magnifying power of the convex lens. I have always been in the habit of placing +10 behind the mirror, and using +3 as the objective lens. This is a very convenient combination, and magnifies the inverted image to about three-quarters of the diameter of the erect image.

To render the new ophthalmoscope as convenient as possible, I had the lens +10 placed between the empty aperture and the lens +2 instead of between the lenses +8 and +12. The reason of this displacement is that I begin, as above mentioned, ophthalmoscopic examinations with the investigation of the refractive media, using the mirror unaided ; then I examine the fundus in the inverted image, using +3 as objective and +10 as ocular. This completes the examination in the majority of cases, and therefore I want the ocular which I constantly use for the inverted image to be placed next to the empty aperture in the disk. This arrangement, which has no other advantage than to save time, I recommend to every emmetropic observer who is not yet presbyopic. The employment of a convex

ocular, though not unknown, deserves to be more extensively adopted and appreciated. Messrs. Miller Bros. will place +10 or any other number near the empty aperture, if desired; if not, the lenses follow one another in their regular order.

The series of test-glasses represented by the two disks answers all practical purposes. I chose 48 as the weakest glass, as we hardly prescribe weaker spectacles. The ophthalmoscopic discernment of a refractive interval of $\frac{1}{48}$ seems to be sufficiently nice, yet it is not the limit of this mode of investigation, for we are able to distinguish $H_{\frac{1}{33}}$ from $H_{\frac{1}{48}}$ which represents a refractive interval of $\frac{1}{88}$; we can distinguish even $H_{\frac{1}{48}}$ from $H_{\frac{1}{60}}$, which is a difference of $\frac{1}{120}$. If, in future, a greater cultivation of the method of determining the state of refraction with the ophthalmoscope—which may be termed “*Ophthalmoscopic Optometry*”—should require a weaker glass, +96 and -96, or other numbers, might be added to the instrument without making it inconvenient. Should we, even now, need a weaker number than 48, we can easily obtain it with the present instrument by combining a convex number with a concave one of different refractive power; for instance +33 in combination with -48 gives +106; and -33 with +48 gives, of course, -106. By such combinations we may obtain a series of glasses of great variety, yet is it more convenient to have the numbers which are most in use always ready at hand, without being obliged to resort to combinations. It saves time, the great factor in all our pursuits, and that one over which we have no control.

I give here the series of lenses which I have found to be most appropriate, and add the difference or the interval of refraction between every two successive numbers:

2	3	4	6	10	12	14	17	20	24	33	48
6	12	24	40	60	84	79	113	120	88	106	

It is easily understood that the combination of two successive glasses, if the one be positive and the other negative, results in a lens the power of which is equivalent to the interval of refraction between the two glasses, and will be a collective lens if the stronger glass be positive, but a dispersive lens if the stronger glass be negative. The intervals from No. 8 to No. 48 are small enough to need no combinations, and these are the numbers most frequently required, whereas the stronger numbers are less used. Yet they are necessary, and the lenses enumerated above are not sufficient for the requirements of practice. In highly myopic, and in highly hyperopic eyes it may be of importance accurately to study, with the ophthalmoscope, minute changes in the fundus oculi, or to determine the degree of ametropia. In order to do this we have to resort to combinations, of which our instrument admits a great number, more than sufficient for all purposes.

The following table represents a series of suitable combinations, showing, at the same time, the refractive intervals between the higher numbers contained in the ordinary trial cases, and how near the optical value of a

combination approaches that of the corresponding number in the ordinary series of test-glasses.

The + sign in the last column indicates how much weaker, the — sign how much stronger the combination is than the corresponding number of the ordinary series. The addition of the refractive powers expressed by the two last columns is equal to the refractive power of the numbers in the first column.

Ordinary Series.	Refractive Interval.	Combination in Ophthalmoscope.	Real Value of Combination.	Refractive Difference between Value of Combination and the Corresponding No. of the Ordinary Series.
+ 2		....	....	....
+ 2 $\frac{1}{4}$	18	+ 2 — 17	+ 2 $\frac{4}{16}$	— 306
+ 2 $\frac{1}{2}$	22 $\frac{1}{2}$	+ 2 — 10	+ 2 $\frac{1}{2}$	∞
+ 2 $\frac{3}{4}$	27 $\frac{1}{2}$	+ 2 — 8	+ 2 $\frac{2}{8}$	+ .88
+ 3	33	....	....	....
+ 3 $\frac{1}{4}$	39	+ 3 — 48	+ 3 $\frac{1}{8}$	+ 65
+ 3 $\frac{1}{2}$	45 $\frac{1}{2}$	+ 3 — 20	+ 3 $\frac{9}{17}$	— 420
+ 3 $\frac{3}{4}$	52 $\frac{1}{2}$	+ 3 — 14	+ 3 $\frac{9}{11}$	— 210
+ 4	60	....	....	....
+ 4 $\frac{1}{2}$	36	+ 4 — 33	+ 4 $\frac{16}{29}$	— 396
+ 5	45	+ 4 — 20	+ 5	∞
+ 5 $\frac{1}{2}$	55	+ 4 — 14	+ 5 $\frac{3}{8}$	— 308
+ 6	66	....	....	....
+ 7	42	6 — 48	6 $\frac{6}{7}$	— 336

It is evident that a like series of negative lenses is obtained by reversing the + and - signs in the third column.

If an emmetropic observer, or an ametropic one who has rendered himself emmetropic by using the proper glass, looks from a distance of about one inch, without a correcting lens, and with relaxed accommodation into an eye, and sees the details of its background indistinctly, the examined eye is either myopic or hyperopic. Without moving the ophthalmoscope he then turns, with the index of the hand which holds the instrument, the lower disk in such a way that the concave lenses follow one another from the weakest to the stronger numbers. If the details of the fundus become clearer, the eye examined is myopic, and the degree of M is found when the weakest glass with which the fundus appears distinct is behind the aperture in the mirror. If, on the other hand, the details of the fundus grow more indistinct when the lower disk is employed, the eye examined is hyperopic. The lower disk is now turned in the opposite direction till the empty aperture is again behind the opening in the mirror, the ophthalmoscope is taken into the other hand, namely from the right into the left if the patient's left eye is examined, and the inverse, and then the upper disk is turned with the forefinger of the first hand. This can likewise be done without taking the instrument from the eye. The turning begins at No. 48 and proceeds to the stronger numbers till the strongest glass is found with which the details of the fundus appear perfectly distinct. This glass determines the degree of H.

Another procedure, by which we may as well first

examine whether the eye is hyperopic, is, perhaps, still more convenient, not requiring the mirror to be passed from one hand into the other. In examining, for instance, the left eye of a patient, we hold the mirror with our right hand in front of our left eye, while the two last fingers of our left hand rest upon the patient's forehead, and our left index finger, touching the edge of the upper disk, and the left thumb, touching the edge of the lower disk, rotate the disks at pleasure. Every one will easily find out a method which is convenient to himself.

Ophthalmoscopic optometry has two objects: 1, the determination of ametropia independently of the statements of the patients, and 2, the measurement of elevations and depressions in the background of the eye.

Perfect relaxation of accommodation on the part of the observer is the first requisite of a correct determination, while the patient is directed to abstain from any accommodative effort by looking into the distance or into vacancy.

As we ascertain the degree of ametropia by measuring the distance of the far-point of the range of accommodation from the cornea, or the anterior principal, or the anterior nodal plane of the eye, it is easily understood that, in determinations by the ophthalmoscope, the distance of the correcting glass from the examined eye has to be added to the number of the concave lens with which the degree of myopia is ascertained, whereas it has to be subtracted from the number of the convex glass with which we ascertain the degree of hyperopia. If, for instance, — 12 be the weakest glass with which an observer, who holds his mirror one inch from the eye

of the patient, sees the fundus clearly, the degree of myopia is not $\frac{1}{12}$ but $\frac{1}{13}$; on the other hand, if $+12$ be the strongest positive glass with which he sees the fundus of another patient's eye, the degree of hyperopia is $\frac{1}{11}$. Ametropic observers have, of course, to take the degree of their ametropia into account. The simple procedures to do this are too easy to be dwelt on in this place; besides, they are fully explained in MAUTHNER'S *Lehrbuch der Ophthalmoscopie*, Wien, 1868, p. 165, etc. As there is, however, some reckoning required for every ophthalmoscopic determination done by ametropic observers, I would recommend them to have the glass which corrects their ametropia inserted additionally into one or both disks, namely into both, if it be a number not found in the series given there. An observer of $M\frac{1}{2}$ or $H\frac{1}{2}$, for instance, I would advise to have -9 , respectively $+9$, inserted between 48 and 0 into each disk. He is then able to determine the state of refraction of each eye without ciphering, and just as conveniently as an emmetropic observer. If his degree of ametropia is represented by a glass in one disk, he should have the same number additionally inserted into the other disk. He will then gain another opening in the first disk which may be filled by any glass he desires. An astigmatic observer should have an appropriate glass additionally inserted into each disk in the same manner as an ametropic observer, and in case his astigmatism be compound, the additional glass should, of course, correct both his astigmatism and his ametropia. Miller Bros. will make all these arrangements on special request.

The second object of ophthalmoscopic optometry, *the measurement of elevations and depressions in the fundus oculi*, is accomplished by determining in the erect image the states of refraction of the crest and the basis of an elevation, or the margin and the bottom of a depression. Since the optical apparatus in one and the same eye remains unchanged during the examination, the differences in the state of refraction of different parts in the fundus may be found by calculation. I described this method of ophthalmoscopic determination of the relief of the background of the eye at the *Congrès International d'Ophthalmologie*, in Paris, 1867 (see the *Compte-Rendu* of that meeting, p. 165, etc.), and published a table for that purpose in my treatise on the Intra-ocular Tumors (p. 106, English translation). L. MAUTHNER, too, described the same method in his book on Ophthalmoscopy (1868, p. 206, etc.), and E. G. LORING, in an excellent paper: *Determination of the Optical Condition of the Eye by the Ophthalmoscope, with a new Modification of the Instrument for that purpose. Am. Journ. of the Medical Sciences.* 1870, p. 323, etc.

The method is, indeed, nothing but the ophthalmoscopic application of the determination of the length of the ocular axis from known degrees of ametropia.

The calculation is as follows: If we apply the general dioptric formula $\frac{F_1}{f_1} + \frac{F_2}{f_2} = 1$ to the eye, and employ for the anterior and posterior principal focal lengths F_1 and F_2 , the values $F_1 = 15$ mm. and $F_2 = 20$ mm., according to Listing's reduced eye, we obtain, by ophthalmoscopic observation two conjugate focal lengths, f_1 and f_2 . The luminous object is the background of the eye, its image is seen with

the ophthalmoscope, and its position, respecting its conjugate focal distance, is determined by the correcting lens. If we call the conjugate focal distance of the image f_1 , and the conjugate focal distance of the luminous object f_2 , we determine f_1 by ophthalmoscopic observation, and find f_2 by calculation.

The above-mentioned general dioptric formula,

$$\frac{F_1}{f_1} + \frac{F_2}{f_2} = 1$$

transforms into

$$f_1 = \frac{f_2 F_1}{f_2 - F_2}$$

If we deduct F_1 from both sides of the equation, namely,

$$f_1 - F_1 = \frac{f_2 F_1}{f_2 - F_2} - F_1$$

and reduce this expression, we obtain

$$f_1 - F_1 = \frac{F_1 F_2}{f_2 - F_2}$$

$f_1 - F_1$ in algebraic language signifies the distance between the first conjugate and first principal focal points, and $f_2 - F_2$ means geometrically the distance from the second conjugate to the second principal focal point. Let us put $f_1 - F_1 = l_1$, and $f_2 - F_2 = l_2$, the above formula reads: $l_1 l_2 = F_1 F_2$.

This formula and its deduction are taken from Helmholtz's *Physiologische Optik*, p. 49. For the convenience of calculation we write it:

$$l_2 = \frac{F_1 F_2}{f_1 - F_1}$$

because f_1 changes with every auxiliary glass. f_1 , as we have seen above, does not exactly represent the principal focal length of the auxiliary glass, but its distance from the eye has to be added in cases of myopia, and deducted in cases of hyperopia. This distance may be reduced to 20 millimetres. In examining, in the erect image, the patient's right eye with my right eye, and his left with my left, the mirror can, without inconvenience, be held so near the patient's eye that the auxiliary lens is 14 to 20 mm. distant from the first principal plane, that is, the middle of the anterior chamber of the patient. The mirror then touches the patient's eyebrow, and thus is invariably at the same distance from the examined eye, whereas this distance is apt

to vary in different observations, if the mirror has no point of rest on the patient's as well as on the physician's orbital margins. If the mirror is held at some distance from the eye under examination, this distance has to be measured for every available observation; but if one edge of the mirror touches the brow of the patient, the distance of the correcting glass from the anterior principal plane of the examined eye may with sufficient accuracy be assumed to measure 20 mm., which quantity has been used in the calculation of the subsequent table.

I may still remark that, if l_2 is found positive, it lies behind the posterior principal focal plane; if negative, it lies in front of it. *As the table is intended to be a HELP FOR PRACTICE, the first column indicates the auxiliary, i.e., correcting glass, with which the determination is made, but l_2 is computed from the real degree of ametropia*, that is as approximatively as it can be determined with the lenses which, thus far, are at our disposition, and, as is known, are all more highly numbered than their focal lengths would indicate; for instance, No. 36 is in reality $33\frac{1}{4}$; 20 is $18\frac{1}{2}$, 14 is 13, 9 is $8\frac{1}{2}$, etc.

The following table (on page 19) will make it easy to *measure the height of elevations, and the depth of depressions in the background of the eye*. If the eye be emmetropic, the quantity corresponding to each auxiliary glass at once indicates in millimetres the elevation or depression of a diseased part. If the eye be hyperopic or myopic, the degree of H or M may first be determined, and afterward the refractive condition of the part, the elevation or depression of which we want to measure. The difference in the refractive conditions of these two determinations refers to two points, situated on the antero-posterior diameter of the globe. Their distance from each other can easily be computed by referring to the table. For instance, an eye, the fundus of which is seen with + 24, is affected with a small intra-

(To be continued on page 20.)

TABLE

Indicating the ophthalmoscopic determination of the shortening, resp. elongation of the ocular axis by means of positive, resp. negative auxiliary lenses.

Number of Glass.	Obtained by Combination of	Shortening.	Elongation.
± 2	.....	6.12	5.08
$\pm 2\frac{4}{15}$	$\pm 2 \mp 17$	4.93	4.23
$\pm 2\frac{1}{2}$	$\pm 2 \mp 10$	4.80	4.14
$\pm 2\frac{2}{3}$	$\pm 2 \mp 8$	4.27	3.90
± 3	.....	3.95	3.49
$\pm 3\frac{1}{5}$	$\pm 3 \mp 48$	3.68	3.28
$\pm 3\frac{9}{17}$	$\pm 3 \mp 20$	3.32	2.99
$\pm 3\frac{9}{11}$	$\pm 3 \mp 14$	3.05	2.78
± 4	.....	2.91	2.65
$\pm 4\frac{16}{29}$	$\pm 4 \mp 33$	2.63	2.42
± 5	$\pm 4 \mp 20$	2.31	2.14
$\pm 5\frac{3}{5}$	$\pm 4 \mp 14$	2.05	1.92
± 6	.....	1.91	1.80
$\pm 6\frac{6}{7}$	$\pm 6 \mp 48$	1.62	1.56
± 8	.....	1.42	1.36
± 10	.....	1.13	1.09
± 12	.....	0.94	0.91
± 14	.....	0.80	0.78
± 17	.....	0.66	0.65
± 20	.....	0.56	0.55
± 24	.....	0.467	0.459
± 33	.....	0.339	0.335
± 48	.....	0.232	0.230

ocular tumor the crest of which is seen with + 6. + 6 corresponds to a shortening of the ocular axis of 1.91 mm., + 24 to a shortening of 0.47. By subtraction we obtain 1.44 mm. as the height of the tumor. If the eye had shown M_{24}^1 instead of H_{24}^1 , and the crest of the tumor had shown as before, H_6^1 , the elongation of the optical axis corresponding to M_{24}^1 , viz., 0.46 mm., should have been added to 1.91. Then the height of the tumor would have been 2.37 mm. This sort of calculation is so easy to understand that I need give no other examples. The two sets of glasses, however, enable us to determine elevations or depressions without resorting to any calculation, by simply referring to the foregoing table. We determine first either the greatest elevation or the greatest depression of that portion of the fundus the height or depth of which we want to ascertain. For instance, the crest of a tumor, with relaxed accommodation, is seen with + 6. We leave + 6 in its position behind the aperture of the mirror, and diminish its effect by placing concave glasses of increasing strength over it until we see distinctly the basis of the tumor, *i.e.*, the fundus oculi. Suppose this is the case with - 8, then it is clear that the eye is hyperopic. Looking up the shortening which corresponds to + 8, we find 1.42 mm., or very nearly the same quantity which we found before by subtraction. The values thus obtained are sufficiently accurate for the weaker numbers only, namely from 8 to 48, since for the stronger numbers the shortening by a certain positive glass differs too much from the elongation by a negative glass of the same focal length or the same number. For the

stronger numbers this method of leaving one glass in position and determining the optical condition of the other surface with the other disk, could be employed only with glasses which are not obtained by combination, viz., 2, 3, 4, 6. The refractive intervals between these glasses, and consequently the amount of shortening or elongation of the optical axis corresponding to them, is so great that determinations made with these glasses alone are not sufficiently accurate. The shortening with + 2 is 6.12 mm., that with + 3 is 3.95 mm. This is too great an interval, and therefore the necessity of intermediate numbers. In general, the method of determining independently the optical conditions of various points in the fundus, and the addition or subtraction of the values corresponding to their location as found in the table, is to be employed for the measurement of high elevations and deep depressions, whereas the other method of determining one surface with a glass of one disk, which is left in position, while the other surface is examined with the other disk, is available and preferable in cases of lesser elevations or depressions. In the great majority of instances we have to deal with elevations or depressions of moderate extent, namely exudations and excavations, and therefore the simpler method of determination admits of more frequent application.

The shortening of the optical axis relating to convex glasses, as stated in the foregoing table, has no reference to the *aphakial eye*, its optical constants being different from those of the ordinary eye. As elevations and depressions: exudations, excavations, tumors, etc.,

may occur in the aphakial as well as in the ordinary eye, I shall arrange a table also for the aphakial eye. The calculation is done according to the formula we used

for the ordinary eye: $l_2 = \frac{F_1 F_2}{f_1 - F_1}$. The values of F_1

and F_2 are derived from Helmholtz's and my own measurements of the radius of curvature of the cornea. They are $F = 22.6$ mm. ; $F_2 = 30.3$ mm. (See *I. H. Knapp: Die Krümmung der Hornhaut*. Heidelberg, 1859, p. 34.

The use of the *following* table (see next page) seems to need no explanation.

When this paper was finished, I received the September number of *Zehender's Klinische Monatsblätter*, which contains a short notice, accompanied by a drawing, of a new ophthalmoscope by Dr. L. VON WECKER, of Paris. Below the aperture in the mirror of that instrument is a disk which has, near its edge, fourteen concave and ten convex glasses, and is moved by means of a central cog-wheel, from which a stem runs half an inch down the handle. This mechanism admits of the change of glasses without removing the instrument, which the author claims to be of great importance. It is an advantage, providing that the mechanism works well. Though it may be hasty to criticise an instrument without having tried it, I will not withhold some remarks bearing on the usefulness of this instrument in general. If the drawing which accompanies the description illustrates the ophthalmoscope in its natural size, the diameter of the aperture in the mirror measures only 1.5 mm. and that of the auxiliary lenses 2.5 mm. I thought that $3\frac{3}{4}$ mm.

(Continued on page 24.)

TABLE—*Indicating the ophthalmoscopic determination of elevations or depressions in the background of APHAKIAL EYES.*

Number of Convex Glass,	Obtained by Combination.	Position of Fundus in front of 2d princ. Focal Plane.
2	.....	12.11 mm.
$2\frac{4}{15}$	+ 2 - 17	10.73 "
$2\frac{1}{2}$	+ 2 - 10	9.75 "
$2\frac{2}{3}$	+ 2 - 8	9.18 "
3	.....	8.19 "
$3\frac{1}{5}$	+ 3 - 48	7.69 "
$3\frac{9}{17}$	+ 3 - 20	7.19 "
$3\frac{9}{11}$	+ 3 - 14	6.48 "
4	.....	6.19 "
$4\frac{16}{29}$	+ 4 - 33	5.46 "
5	+ 4 - 20	4.98 "
$5\frac{3}{5}$	+ 4 - 14	4.45 "
6	.....	4.16 "
$6\frac{6}{7}$	+ 6 - 48	3.65 "
8	.....	3.13 "
10	.....	2.51 "
12	.....	2.10 "
14	.....	1.80 "
17	.....	1.48 "
20	.....	1.26 "
24	.....	1.13 "
33	.....	0.77 "
48	.....	0.53 "

for the hole in the mirror, and 6 mm. for the lenses were the smallest dimensions which the convenience of use and the very object of the instrument would admit. An ophthalmoscopic examination of the *anatomical* conditions of the eye could be done, and, perhaps, advantageously, with a mirror having a narrower opening than four millimetres, providing that the rays of light emerging from the eye examined impinge upon the mirror at angles not too far from 90 degrees. But when the mirror is held in such a way as to cross the visual line of the observer at an angle more or less acute, the aperture in the mirror is virtually diminished, its projection becoming an ellipse, the small axis of which is shortened in proportion to the slanting of the mirror. This virtual diminution is increased by the metal borders in which the auxiliary lenses are set. An ophthalmoscope which does not admit of easy movements, especially in lateral directions, is not convenient, since it obliges us to place the patient, ourselves, and the lamp in a more or less fixed position. The freedom of movements which the small ophthalmoscope admits of is of great advantage, enabling us to follow up the details of the fundus by moving our heads.

Another drawback which cannot fail to result from a small opening in the mirror is its *action as a diaphragm or stenopæic apparatus*, which, by cutting off the circles of dispersion, prevents us from nicely recognizing the errors of refraction. For that reason Wecker's instrument appears deficient in the very object for the sake of which it was invented.

The ophthalmoscope which I have above described

has now been used more than four months by myself and others, and has given general satisfaction. No faults or drawbacks, either in its design or workmanship, have manifested themselves, or have been pointed out to me. A set of auxiliary lenses, sufficient in themselves for all ordinary purposes, and capable of satisfying all imaginable demands, by admitting of numerous combinations ; a mechanism, at the same time durable and working with ease, seem to render this ophthalmoscope both *complete* and *convenient*, on account of which I feel encouraged to bring it to the notice of the profession.

ON THE DERANGEMENTS OF MOTION FOLLOWING DIVISION OF THE SEMICIR- CULAR CANALS.

BY DR. LOEWENBERG, PARIS.

(Translated by Clarence J. Blake, M.D., Boston.)

ONE of the most curious facts educed by Flourens from his beautiful experiments on derangements of motion in animals is unquestionably that concerning the remarkable movements of the head, as well as of the rest of the body, in animals in whom the semicircular canals had been divided. Having been occupied for many years in the special study of the ear in health as well as in disease, I could not but take the greatest interest in these remarkable phenomena, and determined to undertake a further investigation of this interesting subject, the more so that I believed myself to have found some points of vantage which would lead to a nearer understanding of the mechanism of these symptoms. Instead, therefore, of simply repeating the experiments of Flourens as it had been heretofore done, it appeared possible, by a modification of the circumstances under which the division of the semicircular canals in animals was performed, to obtain further information concerning the conditions necessary to the occurrence of the phenomena. I hoped, for instance, to determine by experiment the question as to whether the movements

of the animal operated upon were really caused by pain, as Flourens believed, and whether, as a rule, consciousness was necessary to the occurrence of the derangements of motion.

The following pages will show how far my hopes were realized, and in what degree I have succeeded in contributing to an understanding of the nature of these mysterious facts. In regard to the curious movements which follow division of the semicircular canals, I would refer to the excellent description in Flourens's work (FLOURENS, *Recherches Expérimentales sur les Propriétés et les Fonctions du Système nerveux. Seconde édition*, page 454, iii.—460, VI.). The symptoms which I have observed in numberless experiments on division of the semicircular canals agree so fully with those portrayed in the work above cited, that I consider any further description of that which has been so often described as wholly superfluous, and will content myself with a concise statement of whatever may be worthy of mention that I have educed therefrom. In the first place, careful dissections of all the animals upon which I have operated have shown, contrary to the views of certain physiologists, that accidental injury of portions of the brain cannot be considered as constituting a cause of these remarkable phenomena.

Such injury accompanying division of the horizontal and small vertical canals is, moreover, entirely out of the question. This is not the case, however, according to my experience with the large (superior) vertical canal. The inner wall of this canal projects so far into the cranial cavity that it is impossible to effect complete

destruction of the canal without lesion of the cerebellum.

My experiments, furthermore, gave a result in opposition to the statement of Professor Czermak. According to his opinion, vomiting is a constant sequence of injury of the semicircular canals. On the contrary, in the large number of experiments which I instituted, this symptom was observed in but one case, following the operation upon a pigeon. As is shown, however, in the following record of the experiment in this case, an undue depth of the incision injured the cerebellum, and upon dissection an extravasation was found in this organ. The vomiting, therefore, was not the result of the injury to the canals, but of the inroad upon the cerebellum, and it appears very probable to me that a similar injury interfered with the experiments of Professor Czermak.

Experiment No. 1, *July 11*, 1869.—The left horizontal semicircular canal of a pigeon was divided on both sides of the vertical canal. The bird ran quietly about the room, and on being thrown down from the table immediately got upon its legs again. Fifteen minutes later, by means of a deep incision, the right horizontal semicircular canal was divided outwards from the vertical canal. Movements of the head from right to left immediately occurred, together with rotatory movements of the body in the same direction. The pigeon repeatedly fell suddenly to the ground; in a few moments there was a single attack of vomiting, and the movements continued.

July 14.—Continuance of the symptoms, but increased

in severity. The pigeon held the head firmly pressed upon the ground, in such position that the occiput rested upon the floor and the eyes were directed upwards. The movements consisted in rotation upon the long axis, and also upon the transverse axis (somerset), and, in addition, exceedingly complicated movements, the head being continually twisted from left to right (the right eye turning towards the left side); if the head was forced into its natural position, it immediately resumed the abnormal position so soon as it was released. (During sleep, and even sometimes while awake, the position of the head was normal !)

Death occurred on July 27th, at noon. The dissection, which was made on the 29th, showed extravasated blood to the right and left of the canals, the middle lobe of the cerebellum hyperæmic, the capillaries especially being filled with blood. Examined with the naked eye, this portion showed a peculiar greenish-yellow color. The osseous as well as the membranous canals were divided, and there was no trace of reunion. On the right side the incision had slightly entrenched upon the vestibule.

In proceeding to repeat the experiments of Flourens, I had in mind to investigate whether any conclusions could be arrived at concerning the nature of the cause of these disturbances. No one has as yet considered, for instance, the point as to whether the symptoms in question have their cause in an *irritation* or in a *paralysis* of the nerves, but it is primarily evident that this question must first be answered before a clear insight into the circumstances under considera-

tion can be obtained. I purposed, therefore, experimenting upon the effects of irritating these canals. The choice of irritants applicable to this purpose was very limited. The use of electricity presented the greatest difficulties, as it was impossible to fix the animal sufficiently for the purpose of observing the result of the irritation; similar objections precluded the use of mechanical means of irritation, as it is very difficult, during the observation of the disturbances of motion, to continue the application of the irritant. I concluded, therefore, to limit myself to the use of chemical irritants, and selected for this purpose common salt, in crystals or in saturated solution. The following experiment, selected from a number performed in the same manner, exhibits the result arrived at:

Experiment No. 2, *July 17, 1869.*—The small vertical canal on the right side in a pigeon was crushed with the forceps so that a portion of the membranous canal was visible. There immediately followed rotation of the head towards the right side, and falling towards the right on movement. A small piece of salt being placed upon the membranous canal, there was no change in the symptoms, but on application of a concentrated solution the bird showed an inclination to press the right side of the head against the wall, and the movements for some little time were more violent than before.

That we have here to deal with the phenomena of *irritation* appears to me unquestionably deducible from the fact that in all cases the application of a concentrated solution of salt is accompanied by an increase in vehe-

mence of the movements; in this connection the circumstance that the bird pressed the head forcibly against the wall, as if for the purpose of removing the cause of pain, is characteristic. These and analogous experiments appear to me, therefore, to prove that *the disturbances of motion consequent on division of the semicircular canals originate in an irritation of the membranous canals.*

We have further to inquire as to the nature of these disturbances of motion resulting from the irritation of peripheral structures. Have we to deal with simple reflex movements, or are the remarkable contortions of the animals operated upon the expression of a pain actually felt, and therefore consciously perceived? This question could be determined only by experiment, and there was but one means open for its solution, namely, the elimination of that organ upon the integrity of which the preservation of consciousness depends—the cerebrum. There were two methods of accomplishing this:

1. Simple extirpation of the cerebral hemispheres (easily performed in pigeons).

2. Anæsthetization of the animal experimented upon.

1. I cite a few experiments in which I endeavored to accomplish the object by the first of the measures above mentioned.

Experiment No. 3.—The cerebral hemispheres were wholly removed from a pigeon, the bird remaining quiet. Several of the semicircular canals on both sides were then divided; the characteristic movements immediately appeared and continued with great vehemence. Five

or six minutes later I removed nearly the entire upper half of the cerebellum. The movements continued with undiminished violence; possibly they were somewhat more complicated than before (?). The symptoms continued the same. On division of the spinal cord, the abnormal movements immediately ceased. (The reflex movements, however, continued.)

Experiment No. 4.—Several of the semicircular canals were divided on both sides in a pigeon. The characteristic symptoms immediately appeared. The cerebral hemispheres were then removed: the movements continued a few minutes and then subsided. The bird remained motionless, but so soon as it was touched or pushed the derangements of motion consequent on the division of the semicircular canals reappeared and continued for several minutes.

Experiment No. 5.—Several of the canals were divided on both sides in a pigeon, with the occurrence of considerable hemorrhage. The characteristic movements appeared as usual, and continued several hours after the removal of the cerebral hemispheres. On the following day the bird was quiet. The movements appeared immediately, however, when the pigeon was touched or pushed.

On examining these experiments more precisely, we find them to show first of all that the removal of the cerebral hemispheres exerts no influence on the occurrence of the derangements of motion, neither does their previous removal prevent the occurrence of the symptoms following division of the semicircular canals, nor are these symptoms resulting from division of the

canals thereby arrested. Removal of or injury to the cerebellum has also no influence on the occurrence of the movements, inasmuch as they can neither be made to cease nor can their occurrence be prevented by this means. Injury to the cerebellum, on the other hand, renders the movements still more complicated, as it adds to the symptoms consequent upon irritation of the semicircular canals those resulting from injury of the cerebellum.

In this connection Experiment No. 8, in which the combined movements first appeared when an injury to the cerebellum was added to that of the canals, is of interest.

These experiments on pigeons from which the brain has been removed exhibit the peculiarity that in such cases the derangements of motion persist but for a short period and then cease, to be renewed, however, on striking or shaking the bird. In Experiment No. 5 only, in which the division of the canals was accompanied by a considerable hemorrhage, did the movements continue for a couple of hours after the removal of the cerebrum. On the following day, however, the bird was in the same condition as that of other pigeons from which the brain had been removed. This peculiar phenomenon is most important, and contains the key to the knowledge of the true nature of these derangements of motion. We will therefore consider this point at greater length hereafter.

2. We will now consider the experiments in which the birds were chloroformed.

Experiment No. 6.—A small sponge saturated with

chloroform was held to the beak of a pigeon for a few moments. The bird dropped its head and remained quiet. The loudest noises caused no change of position. The horizontal canal and one vertical canal on the left side were then divided. Some movements of the head from left to right immediately occurred.

The corresponding canals on the right side were then divided, the result being violent movements of the head from right to left, and *vice versa*, accompanied by falling, and an impossibility to maintain the equilibrium. About half a minute later the pigeon remained quietly standing, the movements of the head having also ceased. On striking or shaking the bird the movements reappeared, to disappear in a few moments. Ten or fifteen minutes later the bird made a voluntary attempt to move from its position, when the characteristic movements immediately reappeared, with even greater intensity than when under the influence of the anæsthetic. The bird finally regained consciousness, and endeavored to escape by flying. The remainder of the experiments completed under chloroform gave precisely similar results: the movements appeared immediately after the operation, disappeared at the end of a few moments, only to reappear when the bird was struck or shaken. So soon as it awakened from the narcosis the characteristic movements began. (In these experiments only minimum doses of chloroform should be used, as the pigeons are easily killed thereby.)

The results of these experiments, on the whole, are entirely in accord with those obtained in pigeons from which the cerebral hemispheres were removed.

In both series of experiments the derangements of motion appear immediately after the operation, and soon subside, to be reproduced only by a change in the position of the bird. The observation made upon pigeons from which the brain was removed, that when the division of the semicircular canals was accompanied by considerable hemorrhage the movements continued for a long time, from half an hour to an hour after the operation, and ceased only at the expiration of this period, is equally applicable to the experiments under anæsthetics. Precisely similar symptoms were observed during sleep in pigeons in which the semicircular canals had been divided; the movements ceased entirely, but recurred so soon as the bird was awakened by a noise.

It is now proper to seek for the interpretation of these two groups of experiments made upon birds deprived of consciousness. There is no difficulty in doing this, if we take into consideration the following points:

1. The derangements of motion resulting from division of the semicircular canals occur even when the birds are in conditions in which they neither perceive pain nor are capable of voluntary movement. It follows necessarily that the derangements of motion are of *reflex origin*, and furthermore, in reference to the explanations above given, that they are a consequence of *irritation of the membranous semicircular canals*.

2. Upon division of the semicircular canals of animals which are unconscious, the resultant movements possess the peculiarity of continuing but a short time after the operation, and, when they have once ceased, of being recalled only by moving or shaking the animal.

This fact proves that in animals operated upon under these circumstances the irritation is not a continuous one, and recurs only on movement.

The manner in which movement causes renewed irritation is readily comprehensible: the most insignificant hemorrhage, the slightest mechanical shock, even mere contact with air of a different temperature, is sufficient to excite intensely an organ so exceedingly sensitive as the membranous semicircular canals. Of the accuracy of this explanation there is evidence in the fact—

3. That even in animals in a state of unconsciousness the derangements of motion continued for a long time in cases wherein the division of the canals was accompanied by severe hemorrhage.

We may now introduce the question as to why it is that these reflex movements are continuous in normal animals, but on the other hand discontinuous in animals which are unconscious.

At the first glance this phenomenon appears to stand at variance with the well-known fact that reflex movements in animals which have been deprived of consciousness are usually more violent than in animals in the normal condition. This contradiction is, however, only an apparent one. We have seen (*sub 2*) that the discontinuance of the movements following division of the semicircular canals is merely a result of the discontinuance of the irritation, which is always reproduced by a movement of the animal.

Birds with the cerebrum intact, however, make continual attempts at flight, and it is these movements which keep up a continuous irritation.

In animals deprived of the function of the cerebrum, the intensity of the derangements of motion is only *apparently* less than in animals under comparatively normal conditions, and this appearance rests simply on the fact that in the first case the irritation which calls for the reflex movements persists but for a short time. If the irritation is present, the derangements of motion in the latter case, if not more violent, are at least as violent as in pigeons in which the brain is intact.

It is also not impossible that the flying movements which the bird, whose cerebrum is uninjured, makes after the division of the semicircular canals, are partially due to the pain resulting from the operation; and yet, even if this were possible, it would not in the least follow that Flourens was correct in attributing to pain alone the derangements of motion following division of the semicircular canals. The difference between the results of my experiments and the conclusions drawn by Flourens is very great. According to my experiments these movements are of a purely reflective nature, and occur without the presence of consciousness. When consciousness or the appreciation of pain co-operate in the production of these movements, it is only indirectly by exciting the bird to voluntary attempts at flight, and thus affording a cause for the origin of the reflective irritation. According to Flourens, on the contrary, the appreciation of pain is the direct origin of the derangements of motion, and according to his view the bird makes the characteristic movements of the head for the purpose of removing the cause of the pain. But one objection, so far as I am aware, can be raised to the

conclusion deduced from my experiments, and that is as follows: "If each movement of the animal operated upon," it might be said, "causes irritation of the membranous canals, the derangements of motion in pigeons from which the brain has been removed should also be continuous, because, if the bird has once made the abnormal movements in consequence of irritation of the canals, these as well as every other movement must induce further irritation, which would call forth a repetition of the derangements of motion, these producing further irritation of the semicircular canals, etc." The force of this apparently important objection is, however, diminished by the following consideration. The violent convulsive movements made by the bird induce exhaustion both of the motor nerves and of the muscles, and also of the sensitive portions of the membranous canals. Rightly considered, these movements do not continue undiminished in animals with normal brains. In these cases pauses of some minutes occur, during which the animals are quiet as the result of exhaustion. The difference between normal pigeons and those from which the brain has been removed is merely this, that the former, so soon as they have rested, commence making voluntary movements which induce irritation of the membranous canals, while the latter, when once brought to a condition of quiet by exhaustion, remain in that condition until some external impulse again sets them in motion. In a word, exhaustion breaks the chain of phenomena which was implied in the objection just urged.

My experiments having convinced me that the de-

rangements of motion following division of the semicircular canals of the labyrinth were of reflex character, the next point was to determine the *place of transmission of this reflex*. Before directing my experiments to the spinal cord, it was necessary to examine as to whether the transmission might not take place in some portion of the brain which had been left intact in former experiments, namely, in that portion designated as the thalamus.

Experiment No. 7. *Aug. 5, 1869.*—The cerebral hemispheres were entirely removed from a pigeon of medium size. On subsequent division of some of the canals on the right side, the bird made a few movements of the head. The canals of the left side were then divided, followed by violent movements of the head and rotatory movements of the body (the head being carried towards the left). I then removed the cerebellum; the movements continued for a short time in diminished intensity, and finally manifested themselves only by slight movements of the head. Upon placing the pigeon on the ground the rotatory movements recommenced in the same direction as before; the head was pressed with the occiput against the ground. Upon removal of the thalami optici, the head rested quietly upon the ground, and the bird died.

Experiment No. 8. *Aug. 5, 1869.*—The cerebellum was mutilated in a pigeon. Rotatory movements backwards and towards the left followed. The canals on the right side were then divided, when there occurred violent movements of the head and the body of a complicated character. These were not “mouvements de

manège," but a reeling from right to left. The canals on the left side were then divided. The movements remained the same in character, but the excursions were greater. The pigeon dashed the head forcibly towards the right (previously towards the left). The cerebral hemispheres were then removed. The movements continued. I then removed the remainder of the cerebral substance and the thalami. The movements ceased and the bird remained alive.

Experiment No. 9. *Aug.* 12, 1869.—I removed the right cerebral hemisphere and the right thalamus from a pigeon. Immediately thereafter the bird twisted the head downwards, so that the beak was directed upwards. In so doing the head was twisted from left to right. The bird then turned violent somersets backwards, at the same time falling towards the right side. Shortly after the movements of the head ceased. I then divided the external vertical canal on the right side. The pigeon immediately shook the head from right to left; the body was supported upon the tail and rotated from left to right. The pigeon fell towards the right. I then removed the left cerebral hemisphere and the left thalamus: the movements immediately ceased entirely. Division of the left external vertical canals did not cause them to recur.

These experiments show that removal of the thalamus is followed by immediate cessation of the movements even in those cases in which the birds survived the operation for some time. (See Experiment No. 8.)

The ninth experiment shows, furthermore, that the removal of one hemisphere and one thalamus presents

no hindrance to the occurrence of the symptoms, but that the latter cease only so soon as the thalamus of the remaining side is removed. We cannot, of course, attach any importance to the movements which occurred after simple removal of one hemisphere and one thalamus. In these experiments the circumstance that, following division of one of the right vertical canals (therefore only unilateral injury to the semicircular canals), violent and continued movements occurred, and further that these were, not as is usual from the wounded to the normal side, but in a contrary direction, is particularly remarkable and difficult of explanation.

It is proved, therefore, by the above experiments, that the transmission of the irritation from the sensitive portions of the semicircular canals to the motor nerves which take part in the production of the derangements of motion, occurs in the thalamus. This result naturally obviated the necessity of proceeding to experimental division of the spinal cord. The results of experiment No. 9 are difficult of explanation. Is it possible that a portion of the nerve-fibres coming from the canals intersect in the thalamus?

Condensing the results of my experiments on pigeons, I believe that I have proved the following points:

1. That the derangements of motion following division of the semicircular canals are the result of this injury, and not of an accompanying injury to portions of the brain.

2. That the vomiting observed by Professor Czermak

in his experiments was the result of an accompanying injury of the cerebellum.

3. That the derangements of motion are the result of irritation of the membranous canals, and not of paralysis.

4. That the irritation of the semicircular canals produces the convulsive movements *reflectively*, without participation of consciousness. Consciousness participates in these effects only in so far as it gives rise to renewed irritation, by inciting the animal to voluntary movement.

5. The communication of this reflex excitation from the nerves of the membranous semicircular canals to the motor nerves takes place in the thalamus.

APPENDIX.—EXPERIMENTS ON RABBITS.

According to a well-known observation of Dr. Brown-Séquard, division of the nervus acusticus induces the same derangements of motion as lesion of the semicircular canals. In this connection I have instituted a series of experiments on rabbits, which I will briefly describe, and of which the following experiment serves as an example:

Experiment No. 10.—The nervus acusticus in a rabbit was divided from the tympanum. (See the method described by Claude Bernard for division of the facialis, in his *Leçons sur la Physiologie et la Pathologie du Système nerveux*. Tome ii., 18 et 19.) For this pur-

pose the knife was carried into the tympanum forwards and upwards. There immediately followed the characteristic movements of the head from right to left, and, in addition, the "mouvements de manège." The right ear seemed to have lost its hearing power. The "mouvements de manège" continued for several days, but diminished in intensity during sleep. If the animal was shaken or struck, they increased in violence. On the third day the animal was killed. The dissection showed that while the right auditory nerve was almost completely divided, at the same time the semicircular canals of this side were partly crushed and partly broken in. Other experiments gave precisely the same result. In all cases the canals shared in the injury. A division of the *nervus acusticus*, therefore, without accompanying injury to the semicircular canals, cannot be accomplished (at least by this method).

In these experiments the constant occurrence of the "mouvements de manège" without injury (as was shown on dissection) to any portion of the brain was remarkable, and furthermore, the occurrence of continuous derangements of motion accompanying only unilateral injury of the canals. Vomiting was not observed in any of these experiments.

Remark.—The preceding paper, written in French, was sent, competing for a prize, to the *Académie des Sciences, in Paris*, on June 6th, 1870. External circumstances prevented the author from publishing it earlier, and from availing himself of later researches, especially those of Prof. GOLZ. The preceding investigations, starting from new points of view, yielded results which are, perhaps, not unworthy of the notice of the profession.

THE AUTHOR.

EMBOLISM OF THE CENTRAL ARTERY OF THE RETINA.

BY DR. J. SAMELSOHN, OF COLOGNE.

(Translated by Dr. Hasket Derby, Boston.)

A CASE of blindness occurring in connection with the chain of symptoms which characterize embolism of the central artery of the retina, is still entitled to be regarded with more interest than a single observation in most instances is capable to elicit. For the hope expressed by Virchow,* in closing his classical researches on thrombosis and embolism, that—"if a chance should be offered of making an ophthalmoscopic examination in cases of very recent embolism of the larger retinal arteries, it might be possible, during life, to distinguish the occluded portions by their whiteness and trace directly the progress of secondary derangements, all of which would have a most valuable bearing on the theory of metastasis"—this hope has been only partially realized. It is true that we are at present in possession of a satisfactory though not very large number of observations in which the diagnosis of obstruction of retinal vessels by embolism is well made out, though unsupported by anatomical proof.† It is true that Knapp has

* Gesammelte Abhandlungen, p. 723.

† Cf. Stellwag v. Carion, *Lehrbuch der Augenheilkunde*, 1867, p. 791. Roth, *Ueber Netzhautaffectionen bei Wundfieber*. *Deutsche Zeitschrift f. Chirurgie*, Bd. I. Heft 5, p. 471.

recently described* a hemorrhagic infarctus as the keystone, so to speak, to the picture of derangements in the circulation of the retina caused by embolism ; but the analysis and the history of all these observations are, in many respects, so varying and even contradictory, both in the apparently similar mechanical conditions and in the consecutive, nutritive and functional derangements, that a general description of the disease under consideration can only be given with the utmost caution, and a diagrammatical explanation of the secondary derangements, or an elucidation of the process of metastasis, has, from this part at least, hitherto been out of the question.† It is only since Cohnheim's‡ recent luminous investigations have cleared up the subject of mechanical derangements of the circulation succeeding arterial embolism, and especially since the vague conception of collateral fluxion has been reduced to its proper proportions, that it will perhaps be possible to marshal the numerous variations of the observations on record, in obedience to an ordered system, to subject the published cases to a more rigid criticism, and to find a surer foundation for diagnosis.

Before, however, I discuss previous observations with reference to the results gained by the experiments of Cohnheim, I would crave permission to report an original observation, which excited me all the more to this investigation by its coincidence with the appearance of Cohnheim's work.

* Archives of Ophthalmology and Otology, Vol. I., I, 1869, 64-84.

† Steffan, Ueber Embolische Retinalveränderungen, Graefe's Archiv, XII., I., p. 42.

‡ Cohnheim. Untersuchungen über die embolischen Processe, 1872.

Maria P., a woman of no especial vigor, 62 years of age, came to me, August 2d of this year, complaining that fourteen days ago, after passing a quiet night, she remarked in the morning entire blindness of the left eye, although she was perfectly certain of having seen well with it the evening before. On awaking, she had a feeling as though this eye were shut, and consequently asked her husband to take a look and ascertain why she could not open it.* Being informed by him that it was open, she experimented on the acuteness of vision of each eye, and found that with the left she could not even distinguish light from darkness. She at once consulted an oculist, who told her there was nothing to be done for the eye, that it was lost. Alarmed at this opinion, she went to another, who ordered her iodide of iron, but said nothing about her condition ; and it was at the end of fourteen days that she came to me to obtain my opinion concerning the disease.

The objective examination showed the following :

The *right* eye, emmetropic, has $S = 1$, and the amount of accommodation corresponding to the age of the patient. In spite of the normal acuteness of vision the patient insists that all objects seem *smaller* to her than formerly. As no comparison with the appreciation of magnitude by the left eye could be made, I was unable to estimate at its proper value the correctness of her statement. This seeing things smaller, however, inspired her with much apprehension for the future. Ophthalmoscopic appearances normal.

In the left eye there is a dull quantitative perception of light in the eccentric portion of the field lying upwards and inwards ; a large lamp being distinguished when held close before the eye, while in the central and remaining portions of the field entire blindness prevails. The cornea and iris are unaltered ; the pupil is

* Steffan's patient experienced the same feeling. L. c., p. 36.

moderately enlarged, as in cases of paralysis of the oculomotorius, and reacts with extreme sluggishness when exposed to light ; still, this reaction is independent of the movements of the other iris, and is incontestably present. The intra-ocular pressure is perceptibly heightened, albeit to no great extent.

Ophthalmoscopic Examination. — The transparent media are entirely clear, the refraction of the eye emmetropic. On bringing the fundus into focus the attention is at once arrested by the threadlike appearance of the retinal vessels, it being at first sight impossible to distinguish between the arteries and the veins, the reflex due to the tubular form of the arteries being wholly wanting. On closer examination it is seen that the papilla has clean-cut edges, *is surrounded by no retinal cloudiness*, and is tolerably pale, but still by no means exhibits the dazzling whiteness of atrophy. The paleness here described is all the more marked by the sharp contrast it offers to the *normal redness of the fundus*. The veins emerge with narrowed channel from the vascular centre of the papilla, and gradually increase in diameter as they approach the periphery, but even at the equator attain to scarcely half the thickness of the veins seen in the other eye. They convey blood throughout their whole course, and exhibit no portions free from blood with oscillating movements. The arteries depart from the point of entrance of the vessels as thin, bright-red threads, and become in part brighter, but less visible, as soon as they pass beyond the edge of the papilla, owing to the lessened contrast between them and the red fundus oculi. One artery proceeds,

in the inverted image, downwards and inwards, is accompanied for a certain distance by a vessel readily made out to be a vein, and gives forth a dark-colored, spindle-shaped swelling, starting off from the thread-like vessel at a distance of about one and a half diameters of the papilla from the edge of the optic disk ; just behind this enlargement the vascular canal entirely escapes recognition. The most rigid investigation in the upright image fails to detect any oscillating movement in the contents of this vessel. The vein corresponding to this arterial division is the fullest of any of the fundus, and tapers but slightly as it approaches the point of entrance of the vessels. The whole extent of the macula lutea has a bloody tinge, is not surrounded by any whitish opacity, does not look like the seat of an extravasation, but, on the contrary, seems, in spite of its redness, to preserve a uniform granular appearance, and keeps its normal line of demarcation from the vicinity (it being remembered that the boundaries, at an age like that of the patient, are not particularly marked or circumscribed) ; it is, however, remarkable that the vessels, so thin throughout the remainder of the fundus, assume such prominence in the region of the macula. The strongest pressure on the eyeball excites no arterial pulsation ; the phosphenes are perfect.

Of the significance of the ophthalmoscopic symptoms there could be no question. The sudden advent of blindness, the striking diminution in size of the vessels, especially of the arteries, the enlargement of the veins towards the periphery, the impossibility of exciting arterial pulsation by pressure, all pointed to a cutting off of

the arterial circulation. In what portion of its course the principal artery was obstructed could hardly be ascertained after a lapse of fourteen days, inasmuch as collateral circulation had probably been set up. It appeared, however, certain that the occluding clot could not be in the ophthalmic artery, inasmuch as the choroïdal circulation was not only unimpaired, but seemed even more vivid than in the other eye, to judge from the existing increase of intra-ocular pressure. As has been stated, a spindle-shaped swelling could be made out in one artery, on either side of which the vessel was extremely narrowed. The whole region gave the impression that we had here to do with a small embolus, which had obstructed a single branch of the central artery. This observation agrees entirely with that of Cohnheim, according to which *the channel of the vessel is more or less dilated at the point of obstruction, but appears decidedly contracted both in front of and behind it.**

The second and principal embolus must, of course, be situated in the trunk of the *arteria centralis retinae*, at what point will be discussed further on. The source of the embolus was the next question. The most thorough examination of the heart and the large vessels revealed nothing in the least abnormal to either percussion or auscultation; the radial arteries, however, especially the left, showed hard atheromatous deposits in the middle coat, yielding to the finger the familiar sensation of a bird's trachea. Inasmuch as an atheromatous condition of the cerebral arteries is frequently present with-

* Loc. cit., p. II.

out any manifestation of atheroma in the remaining arteries of the body, while conversely atheroma of the arteries of the body seldom fails to implicate those of the brain, it became necessary to assume some process within the internal carotid or ophthalmic arteries, from which diseased vascular region the current of the circulation swept particles of tissue or thrombic clots into the central artery and one of its branches.* The inducement to believe in some such disease of the cerebral vessels and the consequent derangement of nutrition of the organ itself became all the greater when it was considered that the woman had previously been both cheerful and lively, but of late had grown melancholy, lachrymose, and had come to be haunted by impressions of impending misfortune ; the veins of the face, moreover, exhibited unmistakable symptoms of stagnation of the circulation. Urine normal. I venture only to hint at the possibility of a connection between the micropsia of the right eye and the above-described derangement of nutrition.† The following points bore on the question of therapeutics :

1. The mobility of the pupil when exposed to light, and the perception of light, slight though it was, in a limited portion of the visual field ;
2. Phosphenes responding to pressure ;
3. Absence of any striking alteration of tissue in the retina ;
4. Absence of any cardiac disease.

* Cf. Steffan, *loc. cit.*, p. 39. Liebreich, *Deutsche Klinik*, 1861, No. 50, p. 476.

† Cf. Panum. The apparent Size of Visible Objects. *Graefe's Archiv*, Bd. V., 1, p. 16.

The slight but still uniform and equal fulness of the arteries and veins giving good grounds for belief that the collateral circulation proceeded from the ciliary vascular plexus, the first indication seemed to be, by stimulating this, to cause an afflux of blood towards the retina that should not only prove a source of nutrition to its tissue, but also enable it to resume its functions. For thus must we theorize with regard to the apparently singular fact that a failure of nutritive supply may not cause the destruction of a tissue, while leading to a limitation or entire suspension of its functions; the collateral circulation following directly on the obstruction being sufficient to prevent the necrosis of retinal tissue, but unequal to the task of maintaining an exercise of functions that are necessarily accompanied by a large consumption of material; a view of the case amply justified by analogy in other organs. This view, too, harmonizes very well with the fact of the good preservation of the phosphenes. For inasmuch as the *larger* retinal arteries ramify in the inner, *conducting*, layers of the retina, irritation of which originates the phosphenes, these layers, though their vessels be but partially filled, must retain a certain limited activity beyond that enjoyed by the external, *perceptive*, retinal layers, which are permeated only by the finer subdivisions of the central artery, and must hence remain more empty when the circulation is impeded.*

* Cf. Steffan, l. c., p. 62, whose view of the *exclusive* supply of the external retinal layers by the chorio-capillaris is hardly tenable. I would simply refer, in this connection, to the preservation of the functions of a retina overlying choroidal ruptures, etc.; Knapp, Archives of Ophthalmology and Otology, I., I., p. 169.

The question, of course, arose whether a stimulation of the retinal circulation, provided we could bring this about, might not drive the embolus still deeper into the central artery, and thus gravely compromise the collateral circulation, so recently established. This doubt, upon which the treatment of Schneller's* single successful case was based, appeared to have no bearing on the present one. In the first place, the embolus having remained fourteen days in one place, which it entirely filled, could hardly be assumed to be sufficiently movable to yield before the *dash* of the blood; in the second place, we had a right to argue that the current would follow, by preference, the already open channels of the collateral circulation, a thing proved by experiment, inasmuch as clots generally extend to the *next higher* anastomosis.

Among the means of bringing about an increase of force in the circulation towards the retina, iridectomy occupied the first rank, an additional inducement to its performance being the indubitable increase of intra-ocular pressure. This increase of intra-ocular pressure is a phenomenon both significant and interesting; significant in regard to its results, which impeded the rapid accomplishment of a collateral circulation; interesting with reference to its development, which allows us an insight into the peculiar derangements of circulation that accompany retinal embolism. These derangements of circulation in an eyeball closed on all sides, and provided with two nearly independent vascular systems,

* Graefe's Archiv, VIII., 1, p. 274.

must run a course very different to that observed in the tongue of the frog, the object studied by Cohnheim. In this latter case the single requisite for the formation of a collateral circulation is the presence of anastomoses, and the tissue interposes no obstacle to the re-establishment of a vascular current, while in the former the greater or less rigidity of the sclero-corneal capsule, the tension of which is maintained by the vitreous, offers a very appreciable resistance. The normal retinal circulation is an indubitable adjunct to the amount of the intra-ocular pressure, through the quantity of blood contained in the retinal vessels; still it is now beyond disputation that the choroid and ciliary body are the real source of the fluids that create the intra-ocular pressure. When now an embolic closure eliminates the retinal circulation, how is the intra-ocular pressure affected? At the very first it will undoubtedly decrease in direct proportion to the amount of blood circulating in the retina; this decrease, however, is partially neutralized, and finally reduced to a minimum by the elastic contraction of the envelope of the globe. The situation, however, almost immediately changes. The obstruction of the central artery drives the blood into one or several of the preceding lateral branches of the ophthalmic, and causes it to flow with increased rapidity into these, *i.e.*, the ciliary arteries; "with the same increased rapidity the blood traverses the capillaries supplied by the said lateral branches, and runs all the more quickly into the veins that carry it off. This acceleration of the circulation in these arteries, capillaries, and veins remains for a longer or shorter time at the same height,

without causing a rupture and hemorrhage, until finally a gradual and equable distribution of the superfluous current is made over several of the preceding neighboring branches, and an equilibrium thus established." *

I have almost literally transcribed this passage from Cohnheim's article, because this observation, based on experiment, seems to me to furnish the key to a proper conception of the mechanical conditions that ensue on vascular obstruction due to embolism. At a later period we shall more clearly perceive the neglect that has been bestowed on, and the faulty conclusions that have been derived from, this state of things. If these experimental results be applied to the present case, it will be seen that the circulation will be affected as follows: The blood will flow with increased rapidity through the ciliary arteries to the chorio-capillaris and ciliary veins; the process of filtration is thus hastened and the intra-ocular pressure increased; this temporary increase of the inner pressure of the eye hinders again the quick completion of the collateral junction in the region of the optic papilla, and the blood hence rushes with a constantly growing rapidity into the posteriorly situated ciliary arteries. As the intra-ocular pressure increases, the activity of the increased rapidity is converted into an increased lateral pressure, and the filtration pressure of the chorio-capillaris thus increased, so that as a final result of the dilemma we note an increase in the intra-ocular pressure and an impeded current in the direction of the collateral optic vessels, and this in spite of the

* Cohnheim, l. c., p. 9.

vascular distribution at the extremity of the optic nerve that seems so favorable to the quick development of a collateral circulation.

Guided by this reasoning, I decided at once to perform iridectomy, the influence of which to diminish pressure in a similar case had already been tested by v. Graefe.* On the very next day I made a broad coloboma upwards, and took pains to let the aqueous humor escape somewhat rapidly. The day following I could not refrain from a cautious examination of the vision and the fundus, the absence of all reaction rendering this apparently devoid of danger. There could be no doubt of an increased perception of light, extending over a large portion of the visual field; it was, however, in no degree qualitative. Ophthalmoscopic examination revealed a considerable alteration in the state of the vessels; the arteries were much fuller, and distinguishable from the veins by their color as well as by a certain reflex, this distinction being most marked in the arterial branch containing the swelling that has been characterized as an embolus. The central contraction in calibre of the vessel had now disappeared, and with it the spindle-shaped enlargement, but it was, as before, impossible to trace the vessel at its peripheric continuation beyond the embolus. The latter, however, had not changed its position. The result of the following and more comprehensive examination, which was made three days after the operation, was the astounding fact that the patient could count fingers with tolerable cor-

* Cf. Graefe's *Archiv*, V. 1, p. 151. Knapp, Ueber Verstopfung der Blutgefäße des Auges, Graefe's *Archiv*, XIV., 1, p. 219.

rectness, not, it is true, centrally, but with a portion of the retina closely bordering on the centre; only below and inwards no trace of a perception of light had returned, corresponding entirely to the spindle-shaped swelling which lay in the inverted image, below and inwards. Ophthalmoscopic appearances the same as two days before. During the next few days the improvement somewhat progressed; large objects like a watch, key, knife, etc., being made out, and the power of vision gradually approached the centre. A change, too, in the ophthalmoscopic appearance of the macula lutea could now be observed. The blood-red color gradually disappeared from without inwards (inverted image), and gave way to a brownish yellow, without, however, the development of any opacity at this point. I must advert here to one very strange symptom. While the patient, in a darkened room, had an accurate perception of fingers and other objects gently illuminated by a gas-jet at her side, except over that portion of the visual field that has been already repeatedly alluded to, she was yet unable to recognize or state the position of the full jet of gas when carried directly before her eyes. A curious analogy exists between this and cutaneous analgesia, and has been already several times adverted to in cases of amblyopia following a large loss of blood.* It seems to me more an evasion than an explanation of this phenomenon, to say that the retina, long disabled functionally, responds to a slight, but is exhausted by a strong, stimulus, and I simply here note

* Vikentscher, Graefe's Archiv, VIII., 1, p. 213. Colman, Klinische Monatsbl., VII., p. 13.

the fact. Not till ten days after the operation did this symptom disappear and the patient accurately localize the largest flame.

I expected now that the improvement in the power of vision would steadily progress. My hope was, however, disappointed, and soon gave way to the fear that what had already been gained might yet be lost. In this apprehension I was by no means guided by the perception of light, which persisted over the whole surface described, but by the ophthalmoscopic appearance of the retinal vessels; for these began again to exhibit a diminished calibre, especially the branch with the embolus, which latter clearly displayed again a spindle-shaped swelling, on either side of which the vessel was contracted, just as before the operation. It was clear that the diminution of intra-ocular pressure, due to the operation, had begun to lose ground, and that the process of cicatrization was offering a fresh obstacle to the collateral circulation that had been excited.

Under these circumstances the patient was dismissed from the hospital, but has remained under surveillance up to the present time. The ophthalmoscope reveals now the last-described state of things, the vessels being moderately contracted, the spindle-shaped swelling present, the veins less attenuated at their point of emergence, and the macula lutea yellowish brown. The white discoloration of the papilla has not increased, and neither has any alteration in the visual power of the left eye taken place since the examination last described. Nor is the right eye at all changed, and, according to the patient's account, the micropsia remains the same.

I cannot, at present, find any reason for this either in the accommodation or the retina.

On reviewing now the single elements which went to make up the diagnosis of our case, we are struck first of all with the absence of that loss of transparency of the tissue which, with hardly an exception, has characterized every case of embolism of the central artery that has hitherto been described. The objection might indeed hold that this was present during the days that first elapsed after the formation of the embolus, and had already disappeared without leaving a trace behind, when I made my first observation, fourteen days after the advent of blindness. A glance at the best known of the hitherto published cases will most quickly inform us with reference to the admissibility of such a theory.

The table opposite shows that the commencement of opacity of the tissue is ordinarily noted during the days that immediately succeed the embolic obstruction, and that, while the opacity in many cases takes more than fourteen days to disappear, shorter periods are not uncommon. Under these circumstances we are not called upon to decide on the absence of opacity in our case, and are at liberty to rank it with Schneller's, which he observed the twelfth day after blindness occurred, and noted *no opacity of the tissue whatever*. These two observations, however, open the discussion as to whether the early or late occurrence of opacity of the tissues is a necessary consequence of the embolic occlusion of the central artery.

TABLE I.

No.	Name of observer.	Situation and extent of the opacity.	Day it appeared after the attack.	Day it disappeared.	Where recorded:
1	v. Graefe.	Macula lutea and a portion of the papilla.	14	30	Graefe's Archiv, V., 1, pp. 149-152.
2	Blessig.	Macula lutea, papilla and retina below the papilla.	Some hours.	Thirty days later still present.	Graefe's Archiv, V. III., 1, p. 219.
3	Schneller.	Vicinity of papilla slightly veiled.	....	....	Graefe's Archiv, VIII., 1, p. 272.*
4	Liebreich.	Macula lutea.	....	....	Graefe's Archiv, V., 2, p. 263.†
5	Liebreich.	In each of six cases opacity of the macula and the papilla.	1-6	6-7	Deutsche Klinik, 1861, No. 50, p. 476. Atlas of Ophthalmoscopy, Pl. 8, Fig. 4. ‡
6	Steffan.	Macula and papilla.	4	40	Graefe's Archiv, XII., 1, pp. 37-38.
7	Saemisch.	Lower portion of retina.	2	5	Klin. Monatsbl., 1866, p. 34.
8	Schirmer.	Retina and papilla, no opacity around macula.	2	30	Klin. Mon., VI., 41.
9	Knapp.	1 { Macula and 2 { papilla. 3 { 4 No opacity.	5 1 2	19 20	Graefe's Archiv, XIV., 1, pp. 210-220.
10	Knapp.	Retina, macula around the infarctus.	Observed 3 weeks after the attack of blindness.		Archives of Ophthalmal. and Otol. I., 1, p. 64.

* Schneller's case, distinguished beyond nearly all others by a considerable restoration of vision, came under his observation the twelfth day after the advent of the blindness.

† The case is described with much brevity, and hence allows no appreciation of its circumstances.

‡ The opacity constantly occurred, sometimes early, sometimes late, disappearing in like manner. Liebreich gives no further particulars.

A proper estimation of the derangements in the tissues that ensue on the occlusion of an artery is based wholly and entirely on "whether behind the coagulum, between it and the dependent capillary tract, there is given off an arterial branch that directly inosculates with any other artery, or whether such an anastomosis is wanting."* If the latter be the case, that is, if the occluded artery be a terminal one, its embolic occlusion may give rise to a double series of derangements, entirely independent of each other. "First, necrosis, the natural consequence of the cessation of circulation in an animal organ; secondly, engorgement, due to the reversed action of the current of the neighboring vein, a current impeded in the retina by no venous valves. The combination of both chains of deranged symptoms is the infarctus."†

This being the fundamental law, it is a source of surprise that the embolic infarctus of the retina should have been accurately noted in but a single case, while, on the other hand, it adds considerable force to the observation that this infarctus took place in connection with an embolism of a *branch* of the central artery, a branch of whose significance as a *terminal artery* there can be, according to Cohnheim's construction, no doubt. On reading the critical remarks appended by Knapp to his case, we gladly admit that he fell but little short of a solution of the whole process, the final theoretical verdict being reached by Cohnheim's experimental observation.

* Cohnheim, l. c., p. 16.

† Cohnheim, l. c., p. 61.

To bring about an opacity of the tissue, which must be regarded as an optical evidence of necrosis, it is essentially necessary that the artery supplying the tissue concerned should be terminal, the occluded vascular region being, in any other event, simply eliminated from the circulation. If this be the stand-point from which we proceed in our consideration of the retinal circulation, we find at once that the authorities are at variance. While Cohnheim denominates the central retinal artery, at its point of departure from the papilla, distinctly terminal, referring to a point beyond the slight connections between it and the ciliary arteries that here traverse the optic nerve,* Leber says, "The small arteries which proceed from the plexus surrounding the optic nerve go in part inwards, to that portion of the nerve that lies before the lamina cribrosa, in part run more posteriorly into its trunk. Their connections with the branches of the central artery seem generally pretty minute. *Very minute branches are continued also into the retina in the immediate vicinity of the papilla.* It is therefore an established fact that the ciliary vessels contribute to the nutrition of the papilla and the adjoining portions of the optic nerve and the retina. Considering this appreciable vascular connection at the point of entrance of the optic nerve, it is astonishing that, after a complete embolism of the central retinal artery, no more considerable collateral circulation should be established."†

In accordance with these investigations of Leber,

* Cohnheim, l. c., p. 72.

† Graefe's Archiv, XI., 1, pp. 6 and 7.

and as long as they are not controverted, must we base our faith, and hence allow the possibility of an undoubtedly imperfect supply of the retina from these ciliary connections, after an embolic occlusion of the central artery on the further side of the minute connections with the ciliary arteries, and regard only the branches of the central artery as terminal arteries in the full sense of Cohnheim's views. At all events, these direct connections between the ciliary arteries and the retina are so slight as to seriously compromise the nutrition of the latter when supplied from this sole source; and when we note the considerable amount of opacity that accompanies the closure of a branch of the central artery, the assumption will not seem forced that appreciable necrotic opacities of the retina, and consequent incurable destruction of its functional capacity, must result from an occlusion of the central artery at a point beyond the giving off of the ciliary connections. It is both theoretically probable and practically established that, in a necrosis of this kind, the primary impairment will be in the region of the macula lutea, a spot which in the normal state is particularly devoid of vessels. Should the necrosis recede as rapidly as it advanced, it is to be assumed that the embolus is situated at a point particularly favorable to the development of the ciliary collateral current, which collateral current may, as has already been indicated, be sufficient to arrest the necrosis and remedy the opacities that have already been induced, without being sufficiently ample to bring about a resumption of function. The period of occurrence of necrotic opacity of the tissue (aside from spe-

cific, infected embolisms) may thus become a valuable means of diagnosis for us in determining the locality of the vascular obstruction, and the clearing up of the opacity as accurate an index of the time and extent of the collateral connection.

A second point, about which authors exhibit many discrepancies, and which I am apparently allowed by the experiments of Cohnheim to view under a single aspect, is the form and contents of the occluded vessels. The following table (p. 64) bears thereupon.

This table exhibits wide variations in the abnormal state of the vessels, both as regards contents and shape. Although, in the majority of cases noted, the arteries appear appreciably narrowed, and exhibit from the centre towards the periphery a diminution in calibre, there are yet two cases that show a directly opposite state of things (Cases 2 and 7), the arteries being decidedly fuller at their peripheric distributions than at their centre. These two cases, that seem decidedly without the pale of typical embolism of the retina, are capable, on closer examination, not only of entire explanation, but furnish at the same time a clue to the occurrence of extravasations that we have to allude to farther on. For on comparing Case No. 2 with Figure No. 7 in Cohnheim's article,* we see that the whole affair amounts to a replenishing of the occluded artery by means of an arterial anastomosis from the ciliary plexus of the optic nerve, an explanation harmonizing fully with Blessig's remark that the greater fulness of the very contracted

* L. c., p. 16, and plate.

TABLE 2.

No.	Name of author.	Arteries.	Veins.
1	v. Graefe.	Extremely narrow lines.	Thin; their unequal fulness increasing towards the equator.
2	Blessig.	Small red lines; they contain a certain amount of blood some distance from the papilla; in most of them this amount of blood and their diameter <i>diminish</i> as the papilla is approached.	Narrowed and best filled towards the periphery; unequal fulness throughout their whole course.
3	Schneller.	Thin, red streaks confined within two <i>white</i> lines.	Narrow, growing <i>thicker</i> towards the papilla.
4	Liebreich.	<i>Wholly void of blood.</i>	Thin, becoming thick in the direction of the periphery.
5	Liebreich.	Thin.	Thin, tapering towards the point of emergence.
6	Steffan.	Thin.	Thin, tapering towards the point of emergence.
7	Saemisch.	Thin and quite <i>white</i> , at one place some blood is retained; above the white coloration an enlargement. On the tenth day after the advent of blindness some blood could be proved to be contained in the <i>peripheric</i> portions of the occluded arterial branch; the current advancing towards the centre, but still showing an interruption.	The corresponding vein is somewhat enlarged, especially towards the papilla.
8	Schirmer.	Very thin, the column of blood being nowhere interrupted.	On the papilla very thin, at some distance from it abnormally large, tortuous, exhibiting a type of stagnation.
9	Knapp.	1. Very thin and threadlike, quite rapidly decreasing in diameter in the direction of the periphery. 2. Threadlike, single in contour, not to be traced far beyond the papilla. 3. Very thin. 4. Thin, with a slight enlargement on the papilla.	1. On the papilla most narrow and very dark; thicker towards the periphery. 2. Very thin, larger towards the equator. Fulness equal. 3. Well filled, with shifting interruptions. 4. Rather thinner than normal.
10	Knapp.	Thin, like a fine red thread, that becomes suddenly transformed again into a ribbon with a double contour.	The corresponding vein enlarged and tortuous.

arteries began immediately beyond their passage over the edge of the papilla, that is, at the point where, according to Leber, branches of the ciliary arteries directly enter the retina. There results hence the extreme probability that the embolus had been carried down to a great depth in the central artery.

Case No. 7 possesses an entirely different significance. The phenomenon of decided arterial engorgement at the periphery is here presented, not at the commencement of the blindness, but as late as the tenth day. It is probably an instance of a retrogressive movement from the neighboring vein. "It begins at the point of union of the passive with the flowing vein, the latter emptying the greater portion of its contents in the normal direction of the heart, but passing, too, a certain quantity into the immovable venous branch, in a directly contrary direction.* In the case referred to, the vein corresponding to the branch containing the embolus was somewhat swollen, especially in the direction of the point of emergence from the papilla; the fulness of the occluded arterial branch began at the periphery and advanced gradually forward in the direction of the central extremity, *without, however, causing the interruption of fulness* to disappear. A similar explanation may be offered regarding the phenomenon of unequal fulness of the veins, with intermitting motion of their contents, observed in some cases (1, 2, 9, 3), inasmuch as Cohnheim has observed and described a similar intermitting movement, a going and coming, first occur-

* Cohnheim, l. c., p. 18. Fig. 6.

ring when the fulness of the veins has attained a certain height by means of the retrogressive current.*

We find, moreover, laid down in the table that the arteries at times appear thin, or like a fine red streak, or, again, like a fine red line bounded on either side by two fine white lines, or finally, like entirely white bands. As is well known, this utterly varying description on the part of single observers has led Stellwag von Carion in especial to express the doubt as to whether we have not, in the observations in question, to do rather with a perivascular inflammation than with an embolism. But the observations of Cohnheim allow us even here to array all the types described under the head of a general and final cause. A glance at his figures, 4, 5, 6 and 7, gives us the explanatory clue to the possibilities described. The explanatory text teaches us that the different types are simply due to the *rapidity* with which the occlusion takes place; according as the embolus suddenly obstructs the whole trunk of the vessel, or gradually increases from partial to total, so do we remark on either side of it now a tranquil column of red blood, again a tranquil red column behind, and a colorless column of plasma before the obstruction, and yet again a pale, colorless vascular trunk as a consequence of the embolism. And that a process of embolism may occur that *gradually* leads to an entire closure of the canal of the vessel, we find sufficient proof in the records of cases that treat of the obscurations preceding the attack of actual blindness.

* Cohnheim, l. c., p. 19.

TABLE 3.

No.	Observer.	Number and form of extravasations.	Position of extravasations.	Day of occurrence after the attack.	Form of red spot at the macula lutea.
1	v. Graefe.	None.	None.	....	Cherry-red spot in the immediate vicinity of the foramen centrale.
2	Blessig.	Two ecchymoses, the one on, the other near, a retinal vein.	Around the macula lutea.	10	A red spot in the foramen centrale.
3	Schneller.	None.	None.	....	None.
4	Liebreich.	Small ecchymoses on the veins.	Around the macula lutea.	....	....
5	Liebreich.	Ecchymoses in all six cases.	Around the macula and papilla.	....	In all six cases without any detailed information, except that they were situated in the opacity of the macula.
6	Steffan.	Two small extravasations.	At the edge of the papilla, the one below, the other outwards	9	In the centre of the milk-white opacity.
7	Saemisch.	....	....	....	....
8	Schirmer.	....	....	....	At the macula a red spot, easily distinguishable from an extravasation.
9	Knapp.	1. Numerous, striped and spotted.	In the opaque retina, around the macula, extending to the papilla.	5	....
		2. ....	....	....	A cherry-red place around the yellow spot.
		3. One hemorrhage.	Close in the vicinity of the upper edge of the papilla.	2	A small dark-red spot on the macula.
		4. ....	....	....	....

We have yet to consider a symptom by no means constant, namely, that of *extravasation*, with which we

will connect a discussion of the much-argued question as to the red coloration of the favea centralis. Let us then seek to derive from a table some information as to the frequency of extravasation. (See page 67.)

With these cases must be ranked Knapp's observation of the infarctus, made three weeks after the advent of blindness, and in which the numerous hemorrhages *were situated around small venous branches*. The red spot at the macula is recognizable, it is true, on the colored plate, still is markedly different from other descriptions and representations. Of its significance as an ecchymosis there is in this case no doubt.

In the above 28 cases the table exhibits to us 12 instances of ecchymosis, which vary not inconsiderably in number and in size. Their site is generally about the macula lutea, sometimes in the neighborhood of the papilla. On comparing the last table with table No. 1, it becomes evident that, in all cases in which ecchymoses are noted, their sites exhibit proof of necrotic changes of tissue. In 3 cases the hemorrhage is expressly described as proceeding from the retinal veins. As regards, finally, the period of occurrence, we unfortunately find no details given in the most cases; according, however, to the positive observations made in some cases, it happens generally several days after the embolic obstruction. In but a single case (Knapp, No. 3) do we find allusion to an extravasation close to the papilla the day succeeding the sudden advent of blindness.

On collating now these several data and comparing them with the results of the experiments of Cohnheim,

I think we shall find no difficulty in passing judgment on them from a single point of view. It has already been stated that no theory of an arterial hemorrhage in consequence of the collateral fluxion, succeeding the occlusion of the principal branch, can obtain, all the less, indeed, because this collateral fluxion would have to be greatest after the occlusion, and diminish or entirely disappear in proportion as time went on.* The case must be one, therefore, of extravasation from the veins or capillaries, described by Cohnheim as the result of venous accumulation, combined with necrosis of the tissue or vascular walls, and to be regarded as paving the way to an infarctus. A properly typical picture of this infarctus has been furnished us by Knapp, and it is certainly to be regarded as a triumph of ophthalmoscopic observation that the embolic infarctus should be, in this case, pointed out to be a venous extravasation, in entire opposition to the views previously obtaining. This observation has in itself fulfilled the second portion of the hope expressed by Virchow, and cited in the introduction to this article, and the experimental investigations of Cohnheim have rendered possible the pathogenetic elucidation of its mechanical details. Blessig, too, was on the scent of the right solution. "The extravasations occurred subsequently to the dissolution of the retinal elements. This later appearance, as well as the circumstance that hemorrhages into the parenchyma took place only on those portions of the retina that were opaque, and hence liable to be more

* Cohnheim, l. c., p. 88.

thoroughly and quickly affected by the derangement of nutrition, go to prove that the dissolution of the tissue must have been a primary, and the hemorrhage into the degenerated and softened retinal tissue a secondary, symptom. I lay great stress upon this circumstance, because the occurrence of hemorrhagic processes in the vicinity of arteries occluded by embolism is generally explained on the theory that collateral fluxion causes the blood to collect in the region of the occluded arteries, and ultimately brings about a rupture of the vessels."* Although this theory nearly approaches the one of Cohnheim adopted by us, we still see from the sentence immediately following this explanation how slight a conception Blessig had of the *mechanical* concomitants of extravasation, and how this depended on the lack of experimental microscopical observations. For he goes on to say: "It is perhaps a consequence of the sparse collateral communications in the vascular tract of the central artery of the retina, that more pronounced and extensive parenchymatous hemorrhages have not been noted in embolism of the same." The picture drawn by Knapp of retinal infarctus may be considered typical according to the views of Cohnheim, and in the critical analysis of the case there is nothing wanting except the retrogressive venous current from the neighboring vein, a knowledge of which indeed could hardly be theoretically attained. If, on the other hand, it is demanded why extravasations are not met with in all cases in which necrosis of the retinal tissue

* Graefe's Archiv, VIII., I, p. 224.

is found, I would refer to the frequently cited article of Cohnheim,* which contains an exhaustive discussion of the circumstances in question.

We have still to discuss the inquiry as to whether the red spot at the macula lutea, that has grown to be an almost pathognomonic indication of embolism of the central artery of the retina, is to be interpreted as a phenomenon of contrast or a hemorrhage. We find it noted thirteen times in the eighteen cases of the table, and are justified in distinguishing between it and the infarctus, an indubitable hemorrhage into the retina. Among these remaining twelve cases we find the red spot associated eleven times with a white discoloration of the macula lutea. The only time that the red spot existed, without opacity of the macula lutea, we find expressly stated that "a reddened place is met with on the macula lutea, *between which and an extravasation there is a distinct difference.*" (Case 8, Schirmer.) In another of these cases (9, Knapp's third case), an ecchymosis at the upper edge of the papilla is described, and then a small, dark-red spot on the macula lutea alluded to; a similar coincidence occurs, moreover, in Blessig's case: one would think that the question of likeness or dissimilarity would be easily decided, owing to such an immediate juxtaposition of two red spots. In considering Steffan's discussion of the present question,† it is presently discovered that this is based on a false mechanical principle, that of arterial collateral fluxion, and, with its result, the formation of extravasation

* L. c., pp. 85-88.

† Graefe's Archiv, XII., I, pp. 39-47.

in the choroid, must be held erroneous ; hemorrhages from arterial fluxion having been proved by Cohnheim untenable. Looking now at the table with a view of ascertaining the form of development of this red spot in the several cases, we find the description to present no inconsiderable variations. At one time there is a cherry-red spot in the immediate vicinity of the foramen centrale, at another situated on the foramen centrale itself; sometimes it is described as on the macula, and sometimes indeed as around it. In the case I myself observed I found it red, with a granular surface, indistinct boundaries, entirely unlike an extravasation, with no parallax to be made out between it and the neighboring retinal veins.* The red coloration was most intensive in the middle, corresponding to the fovea centralis, and passed through a succession of less brilliant shades till it merged in the normal fundus. Its disappearance was gradual and equal on all sides, the red color slowly melting into the ordinary yellow-brown. The impression made on me by the red patch, I have already described as entirely dissimilar to that produced by an extravasation, and I am very well able to conceive how, when a whitish coloration occupies all of the yellow spot but the fovea centralis, the intensely red centre must appear as a hemorrhage. Inasmuch now as I find no anatomical foundation for a venous hemorrhage in the region, and especially the centre of the macula lutea.; inasmuch, moreover, as no veins quit the

* It seems almost incredible that the binocular ophthalmoscope should be neglected, as a means of diagnosis, in such cases, and a "parallax" gravely alluded to in determining differences of level.—TRANSLATOR.

choroid at the portion posterior to the macula lutea; *inasmuch, however, as the most numerous and vigorous twigs of the short posterior ciliary arteries enter the choroid exactly at the posterior pole,** it is easily seen that the collateral fluxion succeeding the embolism may attract especial notice by its deep-red color, exactly at the point where the vessels are still closely packed together, since this fluxion consists in an acceleration of the current of blood through arteries dilated under an increased pressure, *without any extravasation through the arterial walls being yet brought about.* Inasmuch now as the middle of the yellow spot is colorless, nearly wholly transparent, and at the same time the thinnest portion of the retina,† the normal appearance of the fovea centralis is that of a dark-red spot; if now, on the other hand, an increased redness of the choroidal polar region occurs, the color of the fovea centralis must naturally increase. When, as in my case, this red color embraces the whole macula lutea, in gradually decreasing intensity indeed, and without sharply-defined boundaries, I find in exactly this circumstance an increased support of the theory advanced: for in the first place the thickness of the remainder of the macula lutea is more considerable than that of the fovea centralis, and in the second place the boundaries of the yellow spot are never as sharply defined in old

* Leber. Investigations concerning the course and connections of the vessels in the human eye. Graefe's Archiv, XI., I, p. 14.

† H. Müller. Anatomic-physiological investigations concerning the retina of men and vertebrates. Zeitschrift für Wissensch. Zoolog., VIII., p. 1-122. Gesammelte Abhandlungen, p. 308.

people as in children; from the last circumstance it necessarily results that the superjacent retinal pigment must cause the circumscribed hyperæmia of the choroid to appear somewhat diffuse. This explanation is favored, too, by the gradual and equable disappearance of the red color, without the occurrence of any perceptible change of tissue.

COLOGNE, November, 1872.

ON A PARTICULAR FORM OF HEMOR- RHAGIC GLAUCOMA.

BY DR. SHROEDER,

IN WIESBADEN.

(Translated by Dr. Joseph Aub, of Cincinnati.)

[This paper was read before the Medical Society of the Middle Rhine, at Frankfort on-the-Main, the 22d day of May, 1872.]

THE subject, "On a new form of glaucoma," should not attract the attention of specialists alone, but that of general practitioners; for glaucoma is one of those diseases which form the connecting link between the general practitioner and the oculist, and which should be well understood by the former. When such is the case we may expect that the diagnosis will be made in proper time, and the percentage of glaucomatous blindness will be greatly reduced.

The different classifications of glaucoma made by v. Graefe and Donders are generally known. The cause of the disease is supposed to be a condition of hypersecretion in the interior of the eye, occasioned by irritation of the vaso-motor nerves, and especially the trigeminus. I do not desire to enter into the discussion about the origin of glaucoma, yet feel impelled to call attention to the simple, *i.e.*, the primary, chronic, non-inflammatory glaucoma, and ask where in this case does the primary irritation of the vaso-motor nerves exist? Here you cannot demonstrate the usual causes of sec-

ondary glaucoma, as, for instance, synechiæ, a swollen lens, etc., which could cause a traction of the nerves, followed by hypersecretion. And yet the increase of the intra-ocular pressure and the characteristic excavation of the papilla are there just as well. The explanation of an irritation of the vaso-motor nerves will not hold good for this form of glaucoma.

I hope you will agree with me that in explaining the nature of glaucoma, at least of simple glaucoma, the conditions producing a hypersecretion have been highly overestimated and the absorption of the fluid secreted within the eye has been almost entirely lost sight of. The tension of the eyeball does not need a hypersecretion to become increased ; for this purpose a diminished power of absorption will suffice.

Taking into consideration, therefore,

1. That such a condition exists in senile eyes in consequence of the sclerotic degeneration of the walls of the blood-vessels ; and
2. That glaucoma simplex occurs almost without exception in such eyes,

I came to the conviction by way of exclusion that for this disease the senile diminution of the power of absorption was the most important, if not the only, etiological factor.

If the primary cause of the increase of the intra-ocular pressure once exists, the consequence will be a hypersecretion which keeps up the glaucomatous condition by stretching of the nerves or by placing some mechanical obstacle in the way of the current of blood through the veins of the eye.

The form of glaucoma which will be the principal topic of this paper, and which is designated by the name of *hemorrhagic glaucoma*, is less known than the common forms. It derives its name from hemorrhages which occur in the retina. I will state in a few words what has been written on the subject, in order to distinguish and define clearly the form which I wish to describe.

The affection under consideration is not of frequent occurrence: v. Graefe observed it in 22 cases; Laqueur describes 7 cases of hemorrhagic glaucoma among 268 cases of glaucoma in general. In the statistics of glaucoma which I compiled in Utrecht, with the permission of Prof. Donders, there was not a single case of this kind described. The majority of the patients were of an advanced age. Occasionally atheromatous degeneration of the arteries, and in one case (Hirschberg) a disease of the heart, were demonstrated.

The retinal hemorrhages generally precede the commencement of the glaucomatous trouble by $\frac{1}{2}$ —6 months. The glaucomatous attack itself commences with severe ciliary neuralgia; its hemorrhagic origin can frequently enough be proven even in this stage of the affection. The disturbances of vision may manifest themselves in the most varied forms. Some have observed an excavation of the papilla, whilst others have not. Iridectomy has proved futile. As a rule, enucleation was made.

Coccius described, in the *Arch. f. Ophth.*, B. IX., 1, p. 8, a case of hemorrhagic glaucoma, in which the glaucoma followed two days after the commence-

ment of the retinal process, and in which iridectomy had a most excellent result. v. Graefe declares this result exceptional, and thinks, in my opinion without cause, that the interval between the beginning of the retinal trouble and the glaucoma was likely a longer one, and that the retinal hemorrhages may have existed for several days before an additional hemorrhage produced the disturbance of vision which attracted the attention of the patient. Laqueur (*Annales d'Oculistique*, T. LXI., p. 56-57) has also observed cases of hemorrhagic glaucoma, in which the suddenly occurring retinal hemorrhages instantly caused glaucoma, combined with severe ciliary neuralgia. In this case the hemorrhagic infiltration of the vitreous rendered an ophthalmoscopic examination of the fundus oculi impossible. I will endeavor further on to explain why, in this case, the iridectomy was a failure.

The following case, in which I successfully performed an iridectomy, does not seem unfit to complete the cases so far known :—

Mad. C——, of Wiesbaden, aged 62, consulted me on the 23d day of February, 1872, by the advice of her family physician, for sudden blindness and violent ciliary neuralgia, which had set in two days previously. Until then that eye had enjoyed excellent sight, whilst the right eye had been lost in consequence of chorio-retinitis, with pigmentary deposits in the retina. Functional examination of the left eye showed the vision reduced to quantitative perception of light ; objective examination revealed the existence of increased intra-ocular pressure, diminished sensibility of the cornea, shallow anterior chamber, dilatation and immobility of the pupil, with the characteristic glaucoma reflex from the pupil. A general diffuse (serous) opacity of the vitreous prevented an ophthalmoscopic examination of the fundus

oculi. It was evident that I had to deal with a case of acute inflammatory, primary glaucoma. I recommended iridectomy as the only remedy. On the following day I made the operation without any accident, and it was followed by an immediate and continued diminution of the intra-ocular pressure to the normal state.

Two days following she counted fingers in 3'; after three days in 5', and after five days in 8'. On the eighth day, with +10, she could read Sn. No. 2. On the 20th of March the sight of the eye (which had hypermetropia $\frac{1}{3}$) was almost $\frac{1}{30}$. The field of vision was curtailed inwardly. An examination made three months after the iridectomy showed the same acuteness of vision. The field of vision was contracted inwards to within 4" of the point of fixation, when the distance of the visual object was one foot.

The opacity of the vitreous, which was of a serous, not a hemorrhagic nature, disappeared three days after the operation. Its occurrence I seek to explain by supposing that hyperæmia occasioned serous infiltration of the retina, followed by serous exudation into the vitreous itself. In the now discernible fundus oculi an intensely red, round hemorrhagic spot, half the size of the papilla, appeared between the disk and the macula lutea; the retina in its vicinity was slightly clouded and swollen, and the two arteries which generally run parallel from the papilla to the macula lutea were not to be seen. The papilla was reddened by capillary hyperæmia. No signs of a complicating choroidal trouble. The first idea suggesting itself was that this was a case of primary, acute, inflammatory glaucoma, and that the hemorrhage had occurred after the iridectomy. It is true that retinal hemorrhages seldom are absent in cases of cloudiness of the media and decided increase of tension; however—

1. Under the existing relatively moderate increase of tension in our case, secondary hemorrhage could not be presupposed as a matter of necessity.

2. Those ecchymoses which follow iridectomies, and which appear most frequently in the neighborhood of the macula and papilla, are smaller than the one in our case; and

3. They always occur in greater numbers; occasionally they are scattered over the whole fundus.

4. The other conditions observed with the ophthalmoscope, viz. : cloudiness and swelling of the retina, and redness of the papilla, indicate that a retinal trouble was the cause of the glaucoma.

To this I will add the description of the ophthalmoscopic condition of the fundus on the 19th of May. Papilla moderately white, its margin here and there ill-defined, surrounded by pigment on its inner side. Vessels of the retina, arteries as well as veins, narrow and sharply defined. The former hemorrhage is almost entirely absorbed, yet no white discoloration in its place ; diffuse atrophy of the pigmentary layer ; choroid normal. It is hardly possible to think of the retinal hemorrhages as having occurred during the operation, for this would be followed by an enormously increased intra-ocular tension ; whilst in our case normal conditions of tension could be demonstrated immediately after the operation.

The above-described condition of the retina establishes the fact that the case before me was one of hemorrhagic glaucoma, which differed, however, in several important points, from the common hemorrhagic glaucoma, and closely resembled the cases of Coccius and Laqueur. To render this fact conspicuous, I determined to compare the symptoms of these cases and the one just related, with the symptoms of the common hemorrhagic glaucoma, and from this comparison came to the following conclusions.

The cases on record can be divided into two groups : the larger one comprises the 22 cases of v. Graefe and the cases described by Wecker, Horner, Becker, Hirschberg and Soelberg-Wells ; the other and smaller group consists of the cases described by Coccius, Laqueur, and myself. The first form would be sharply enough defined by the name of "hemorrhagic glaucoma with a prodromic stage," or "secondary hemorrhagic

glaucoma;" whilst for the latter and rarer form I would suggest the name "acute hemorrhagic glaucoma," or "primary hemorrhagic glaucoma."

My reason for making this division will be seen in the following arrangement of differential diagnosis:—

The secondary hemorrhagic glaucoma

1. Has a preliminary stage related to the affection of the retina, and may last 6 months.

The primary hemorrhagic glaucoma

1. Has no preliminary stage; the occurrence of the retinal hemorrhages occasions the glaucomatous condition without delay.

[It is very difficult to explain the fact that but a limited number of cases of apoplectic retinitis become complicated with glaucoma; we might explain it as we explained the occurrence of glaucoma simplex, by assuming a diminished power of absorption in the vascular system of the retina. The supposition of diminished absorption is not a mere speculation, but is borne out by pathological anatomical investigations which have shown infiltration of serum and extravasation of blood in the retinal tissue, furthermore thickening of the walls of the blood-vessels, producing contraction of their calibre, resulting undoubtedly in a diminution of the power of absorption. (See farther below.)

The senile rigidity of the sclera must likewise be of importance in this process.]

The secondary hemorrhagic glaucoma

2. Is easily diagnosed, for the impairment of vision as produced by the primary lesion in the retina causes the patient to consult the physician at an early period. The glaucoma develops, as it were, under the eyes of the physician.

3. It may cause the most varied forms of amblyopia which depend on the degree of the retinal hemorrhage, and secondly on the intensity of the secondary glaucomatous affection. Defects of the visual field may be present or absent (*Hirschberg*, first report of his Eye-Clinic, and *Soelberg-Wells*, *Klin. Monatschrift f. Augenheilk.*, VII., 398). This is sufficient to refute the erroneous assertion that defects of the visual field do not occur in hemorrhagic glaucoma.

4. This form of glau-

The primary hemorrhagic glaucoma,

2. With the exception of Coccius's case, cannot as such be diagnosed, for it presents the appearance of primary acute inflammatory glaucoma. It is only after the vitreous body is sufficiently cleared that we can make the differential diagnosis.

3. The power of vision is usually reduced to the quantitative perception of light.

4. In cases of primary

coma is not only not benefited by iridectomy, but assumes even a worse aspect; and the operation at the same time increases the liability of the other eye to become affected with the same process. The only case of hemorrhagic secondary glaucoma in which iridectomy was of any benefit is the case which *Becker* reported at the Ophthalmological Congress held in Heidelberg in 1869. This was originally a case of nephritic retinitis which formed the premonitory stage of the glaucoma, and was followed by an acute glaucomatous attack, with violent ciliary neuralgia. Iridectomy relieved the pain, but it is not stated whether it reduced the tension of the eyeball and improved the vision.

hemorrhagic glaucoma, iridectomy has, without a doubt, a beneficial effect when made at an early date, as in Coccius's case and my own. In my case the acuity of vision of the operated eye was $\frac{1}{2}$, and with + 10 Sn. No. $1\frac{1}{2}$ was fluently read. There is no doubt that Laqueur delayed the operation too long.

It is easy to account for the uselessness or rather the injurious effect of iridectomy in secondary hemorrhagic glaucoma. What is said of the hemorrhages consequent upon iridectomy in other forms of glaucoma, holds

good here as well ; the removal of the pressure by the evacuation of the aqueous humor produces dilatation and rupture of the blood-vessels. This hemorrhagic tendency is favored by a degeneration of the retinal tissue.

It is more difficult to account for the beneficial effect of iridectomy in primary hemorrhagic glaucoma. Yet some reasons may not be without weight :

1. The retinal trouble having existed but a short time, a degeneration of the retina, predisposing to hemorrhages, has not yet taken place. If, on the other hand, the trouble has existed for some length of time, we likewise find iridectomy useless, as in Laqueur's case.

2. The operation causes a diminution of the intra-ocular tension, removing secondarily the paralysis of the retina occasioned by pressure, and admits of a freer circulation and absorption.

Of late, attempts have been made to loosen the connection between hemorrhagic retinitis and glaucoma, because in a very large number of cases the former does not lead to glaucomatous conditions. In answer to this we may say that glaucoma is but a symptom of the disease in question, and may be wanting in certain cases without losing its importance where it exists. Does it not frequently happen that in marked cases of morbus Brightii, the well-known nephritic retinitis is wanting ? and yet no one would think of disputing the causative connection of this retinal trouble and the renal disease.

I cannot, either, approve of the assertion that a relation of cause and effect between the retinal affection and glaucoma could not be admitted, on account of the indefinite length of time which is apt to intervene between the commencement of the two diseases, and in some cases is of so long a duration that the appearance of glaucoma must be considered as purely accidental.

The occurrence of the glaucomatous symptoms depends upon a disturbed relation between secretion, absorption, and elasticity. These symptoms will manifest themselves the sooner the more the secretion is abundant, the power of absorption reduced, and the resistance of the coats of the eye increased. If, for instance, we have to deal with a moderate effusion of blood causing either no retinitis, or retinitis of slight intensity only, the age of the patient being not much over forty, we need not fear glaucomatous complications. It is only after long continuance of the retinal trouble, the anatomico-pathological consequences of which consist in a decrease of the power of absorption within the area of the retina, and when additional hemorrhages take place, that the elasticity of the sclera will become inadequate to counterbalance the increase of the contents of the eyeball and augmentation of tension is discernible by the touch with the finger.

A smaller quantity of extravasated blood will suffice to produce glaucoma, if the power of absorption is reduced and the elasticity diminished.

It is self-evident that these conditions must have prevailed to a high degree, in our case, to cause glaucoma

to manifest itself at once with the retinal hemorrhage. The considerable increase of the contents of the globe occasioned by the swelling and hemorrhages of the retina, the infiltration into the vitreous, and the senile rigidity of the sclera, seem, indeed, sufficient to cause the simultaneous appearance of glaucoma and retinal hemorrhages. The power of absorption in the retina, owing to the short duration of the affection, which could produce no great alteration in the stroma of the retina, was but slightly disturbed. This explains also the favorable result following the iridectomy.

But that, as a rule, the so-called hemorrhagic glaucoma should be dependent on the retinal trouble, is proved by the conditions found in those eyes which have been enucleated on account of hemorrhagic glaucoma with violent ciliary neuralgia. Pathological changes could only be found in the retina, whilst all the other parts of the eye were normal. These changes were described by *H. Pagenstecher* (*Arch. f. Ophth.*, XVII., 105-106, 110), and furnish the anatomico-pathological basis for my theory of a diminished power of absorption. See the first report of my Eye-Clinic at Nerothal, Wiesbaden, p. 15.

Thus far we have been discussing the seat of the disease producing glaucoma; the question now presents itself to us, whether we should separate the secondary hemorrhagic glaucoma from the other glaucomatous processes, because in most cases of this form iridectomy has proved ineffectual. I think it inadmissible to make the effect of a remedy the basis for the classification of the disease. He who looks upon glaucoma as a

symptom, and operates for the purpose of relieving that symptom, will readily agree that the success of iridectomy will depend upon the character of the original trouble; and if he has had occasion to perform iridectomy in different forms of glaucoma, he will have found that in one form the failures will have been more numerous than in others; but still he will not feel justified in excluding that form from the group of glaucoma. The success of iridectomy will of course be different in different forms; and in tabular statements, which are arranged according to the results obtained, the secondary hemorrhagic glaucoma will certainly rank last.

REMOVAL OF TWENTY-EIGHT SMALL GRAVEL STONES, WHICH LAY SEVEN YEARS IN BOTH EXTERNAL AUDITORY CANALS.—RECOVERY.

By SARA E. BROWN, M.D.,

OF BOSTON.

ON the 22d of July, 1873, I was called to see John Smith, of Clinton, Mass., aged sixteen, an inmate of the School for Feeble-minded Youths, at South Boston, Mass. His general health and physical development were good, but his hearing was so much impaired that he could not hear his own voice, and was consequently losing his speech. Previous to the age of nine years his hearing was perfectly good ; but about that time, while at play, he filled both ears with gravel stones. Those found in the outer part of the meatus were removed at the time by his mother, but those crowded in beyond the junction of the cartilaginous with the osseous portion of the canal, had remained there undisturbed for *seven years* ! On examining the left ear, only a dark mass, completely closing the narrow part of the passage, was visible ; but after syringing away a thin coating of cerumen the obstacle, when touched with a probe, proved, by a sharp, grating sound, to be a smooth, flat stone, partially embedded in the integument. So firmly was this pressed into the canal, that it was only after an hour and a half of patient work with the probe, and repeated syringing with warm water, that it was finally loosened and removed. A little more manipulation and syringing brought out a small, square stone, followed by one of larger size, having a very sharp, almost cutting edge. The first stone, a diamond-shaped bit of slate, measured on the longest surface half an inch, and transversely, from point to point, three-eighths of an inch, and is one-eighth of an inch thick. The second stone, somewhat wedge-shaped, measured from point to base one-

quarter of an inch, and the circumference around the largest diameter was three-quarters of an inch.

On the second visit, July 25th, two large stones and a piece of anthracite coal were removed from the right ear, and one small stone from the left. The appearance of the right ear was much the same as that of the left, only the stone blocking the opening presented a smooth, convex surface ; it was also firmly impacted and held by the surrounding integument. After many trials it was pushed inward at the lower edge, and by further manœuvring so loosened and changed in position, that at last a well-directed stream of water lodged it where it could be seized by the forceps. This stone proved to be of triangular form, having one flat surface ; its longest edge measured one-quarter of an inch, the other two edges three-eighths of an inch each ; thickness, one-quarter of an inch. The irregular, cube-shaped piece of coal, with its sharp, glistening edges, was two lines over one-eighth of an inch thick ; was one-quarter of an inch on the longest side, and had a circumference of seven-eighths of an inch. On the three succeeding visits, twenty-four other stones were removed, making twenty-eight in all—thirteen from the left ear and fifteen from the right. Eight of the stones were nearly as large as the ones of which the measurements are given ; five of them but a little smaller, nine half as large, and but two very small ones, and those the size of the head of a large pin. Their aggregate weight was forty-two grains.

The inner portion of the external auditory meatus of both ears is of larger size than usual, and the space between the membrana tympani and the narrowest portion of the auditory canal is disproportionately large ; in fact, there is a large chamber showing the impression of some of the stones which have lain embedded in it so many years. Both the membranes are whole, and do not appear to have been broken, but bear the prints of the edges and points of the gravel. In the right ear the membrane is very concave, and apparently much thickened ; the epidermis, continuous with the canal and covering the external surface of the membrane, has, by the low, subacute form of inflammation, induced by the irritation and pressure, become opaque and thickened, save where the points and edges of the stones have pressed, and there the membrane is comparatively thin and clear, giving it a mottled or spotted appearance.

On uncovering the membrana tympani, as was done on the second visit, it was found so stretched and relaxed, that pressing on it with the probe caused it to wrinkle in every direction, and at one point the inner wall of the tympanic cavity could be touched. Examination at the last visit, August 15th, shows that the membrane has contracted, and has considerable tension; the manubrium may be dimly seen, and the short process of the incus indicated. In the left ear the membrane is less affected; the handle of the malleus, the plexus of blood-vessels, and the cone of light, are clearly visible. Near the margin of the membrane, in the posterior-inferior segment, a crescent-shaped portion is quite clear and thin, and looks as if wholly unharmed; but the remainder of the membrane has a marbled appearance similar to that of the right ear.

In the left ear the hearing distance for the watch is eleven inches; that of the right six inches, while he hears the voice at thirty-two feet. Since regaining his hearing his mental condition has much improved. He now carries his head erect, and the entire expression of his face and person is more manly and intelligent, and his speech also is being rapidly restored.

BOSTON, *August 28, 1873.*

CONTRIBUTIONS TO THE PATHOLOGY OF CHOROIDITIS.*

BY DR. H. F. B. KORTÜM.

(Translated by Dr. Chas. S. Turnbull.)

ALTHOUGH the choroid may be readily examined with the ophthalmoscope, and choroiditis is by no means rare, yet a complete and accurate description of the inflammations of this tunic is wanting.

Every observer knows the ophthalmoscopic appearances, often so striking in choroiditis, but its different forms have neither been fully specified nor has their etiology been sufficiently traced.

In the later text-books the varieties of inflammation of the choroid are generally specified as serous, plastic, atrophic, and purulent, which may again be subdivided into diffuse and circumscribed (disseminate), and acute and chronic forms. This arrangement may answer, but there has not been so much attention paid to their classification as to their etiology; I do not therefore consider it superfluous to publish cases with details minutely noted. I will here attempt, by relating some histories, to illustrate certain forms about which comparatively little is known.

I. CHOROIDITIS CONGENITA.

Case 1.—Ida J., æt. 10 years, was brought to *Dr. Hirschberg's* oph-

* This paper is the "Dissertatio Inauguralis" of the author, and is inscribed to *Dr. Hirschberg*.

thalmic clinique on the 27th of February, 1871. She has never had good sight, and of late a conspicuous alteration of the left eye had been noticed. The mother, with the rest of the children, were healthy, never having had any disease of the eyes. The father, otherwise healthy and strong, has been near-sighted since a boy, and has been completely blind in his *right* eye for at least eleven years. His vision must have diminished gradually, as he only discovered, whilst travelling, and attempting to use a telescope, that he was blind in that eye; and says that *Von Graefe* pronounced it an affection of the retina and gave an unfavorable prognosis.

The eye being examined showed only quantitative perception of light. The ophthalmoscope revealed atrophiea nervi optici (ex neuritide?), the optic disk being of a dull whitish color.

With the *left* eye he read Jaeg. No. 1, ab 4'', and showed no ophthalmoscopic changes other than those necessarily connected with a high degree of myopia.

Up to this time the child's eye had not been carefully examined, and it could not be determined when the *left* eye became totally blind. An opacity in the lens of the left eye had only been noticed during the last few months.

Status præsens. The girl is small, delicate and anæmic, but all her functions, excepting sight, are normal.

A. The *left* eye is of normal size and shape, pupil of medium width, with a delicate posterior synechia above, the lens grayish white, shining and shrunken, T. not materially diminished, no perception of light.

B. With the *right* eye reads Jaeg. No. 5 slowly at a distance of 4 to 5'' visual field apparently complete. Ophthalmoscopic examination shows the media clear, but there are marked changes in the fundus. The optic disk is reddish, its borders are ill-defined and slightly indented upward and outward in the inverted image. The distribution of vessels is normal, with a scarcely noticeable physiological excavation. Between the optic disk and the macula lutea, but nearer the disk, is a large white patch the size of about one quarter of the disk, and surrounded by other smaller patches, which by their glistening appearance manifest themselves as choroidal atrophies. Somewhat further inward (in the inverted image),

and almost in the centre of the background, is a very large white shining atrophic spot, about four times the diameter of the disk, with black stripes and patches in its area and on its borders. Nearly one diameter of the papilla to the inner side, is a long stripe characterized as choroidal atrophy, the retinal vessels passing over it. This stripe, which extends a considerable distance both upward and downward, has serrate borders, and is surrounded by numerous smaller white patches. There are numerous punctate spots, having the same appearance as the larger patches, seen along the retinal vessels, and above is one of a peculiar, white, shining color.

The *diagnosis* was choroiditis of long standing, probably congenital, followed in the right eye by detachment of the retina and secondary cataract.

The *prognosis* was unfavorable, and the hopes of the parent as well as those of the family physician, that sight could be restored by operation upon the cataractous eye, were not sustained. Recovery or marked improvement in the right could not be expected; on the contrary, there was danger of its growing worse.

The *treatment* consisted in moderate abstractions of blood by Heurteloup's artificial leech, small doses of bichloride of mercury, and iodide of potassium, with complete rest of the eyes.

Sight of the *right* eye was slightly improved, and has remained so. June 10th, child could read Jaeg. No. 4 at 4". As the parents desired the cataract removed for cosmetic effect, if for no other reason, it was extracted. An incision was made with a lance-shaped knife, and the thickened capsule withdrawn with the capsule forceps, and the substance of the lens removed by pressure. The wound healed promptly, and a detachment of nearly the entire retina could now be made out.

Case 2.—Hermann N., æt. 12 years, of Berlin, was brought to the clinic on the 15th of July, 1870.

History. Father of child, æt. 46, also complains of gradual impairment of vision in both eyes for the last ten years, and counts fingers at 4' with either eye. Iris discolored, pupil contracted, posterior synechia, and cortical cataract. Fundus could not be examined, but there could be no doubt of the diagnosis of irido-choroiditis. Had contracted an ulcer upon his penis, but no other history could be

ascertained, and no symptoms were now to be made out. An iridectomy was made downward with a narrow knife, and so the further decrease of visual power was arrested, and some improvement even ensued, which, as the opacity of the lens did not notably increase, will be comparatively permanent.

The boy has had poor sight since infancy. *Status præsens.* Reads Jaeg. No. 5 at 4" with the *left* eye, and Jaeg. No. 14 with the *right* eye at the same distance. There is no appreciable defect in the visual field. There is nystagmus oscillatorius more pronounced in the right than in the left, and divergent strabismus of the *right* eye of 2 to $2\frac{1}{2}$ ". Well-advanced choroidal changes in both eyes are seen with the ophthalmoscope, most extensive in the *left* and better eye, so that the higher degree of amblyopia of the *right* eye must be considered as dependent upon the squint. In *right* eye are large white stripes with black dots and small patches like those found in choroiditis disseminata. In *left* are similar but more marked changes, and one broad, grayish-white, slightly prominent stripe, passes above and near to the papilla, slightly veiling the retinal vessels, looking like newly-formed connective tissue.

The first step of treatment was to make tenotomy of the external rectus, which resulted in considerable improvement of the sight of the *right* eye, with which he could now read Jaeg. No. 5 with +6. It is to be regretted that the reading exercises were not kept up with the requisite assiduity, and, as a consequence, the sight of the *right* eye gradually diminished. (Correcting a squint with mathematical accuracy can only be accomplished by training the binocular vision.)

On February 6, 1871, after a long interval, the patient was again presented, almost totally blind. About two weeks previous, sight had grown much worse, so that he was compelled to absent himself from school for one week, during which time his mother treated him with aperients, under which he improved so as to be able to resume his studies for another week. Two days ago impairment of sight again set in, and he saw less than ever.

Externally the eyes appear normal. With the *right* eye he counts fingers in 4', and reads some letters of Jaeg. No. 16 eccentrically, and upon directing the visual axis inward, counts fingers in every direction. With the *left*, he counts fingers at 6", and there is a large defect

of the visual field upward. The pupil cannot be illuminated when the visual axis is directed forward and downward,* but only when it is directed upward can a red reflex be obtained from the fundus. After dilating the pupil by oblique illumination, there are seen on the posterior surface of the transparent crystalline lens some very delicate red stripes and dots, which are evidently small hemorrhagic deposits.

The *diagnosis* of hemorrhage into the vitreous was obvious. The etiology of this, as is well known, rare occurrence has not as yet been cleared up. In certain cases it can be traced to anomalies of menstruation or disturbances of circulation, while in this case the cause could be referred to a previously diseased condition of the choroidal vessels. Rest in a dark room was enjoined, and applications of ice for fifteen minutes every two hours. (Internally, extractum secalis cornuti aquosum, one grain three times a day.) An artificial leech was applied to the left temple.

The boy exclaimed joyously the first evening that he saw better. Ophthalmoscopic examination showed, when the visual axis was directed upward, large black membranes floating in the vitreous. With oblique illumination, loose red blood-clots were seen to float behind the lower margin of the lens. February 9th.—Dose of ergot doubled. Heurteloup to *left* temple, and cold applications. Some retinal vessels can be seen when the patient looks upward. February 10th.—With *left* eye counts fingers at 7'. February 20th.—Heurteloup again, and ergot having been continued, counts fingers across the room with *left* eye. February 27th.—Reads Jaeg. No. 16 with the *left* eye, aided by +6. The papilla is now visible. March 1st.—Reads Jaeg. No. 7, with +6. Mar. 4th.—Reads Jaeg. No. 5 with +6. Papilla is distinctly visible as well as the stripe above it, and from this stripe a blood-clot projects into the vitreous. The source of this hemorrhage is a new and interesting alteration in the choroid, which certainly did not previously exist. On account of its vivid color, too, this alteration must be considered as having existed a short time only. When the patient everts his eye fully, three stripes of choroidal pigment form a triangular space

* Philip von Walther's witty definition of amaurosis as a condition where neither patient nor physician sees anything, is applicable to those cases also where there is complete hemorrhage into the vitreous.

upon a pink background, over which some retinal vessels are seen to pass. These stripes reach from the optic disk to the periphery of the fundus, as far as it can be seen through a moderately dilated pupil. Mar. 27th.—Left, Jaeg. No. 1 with +6. Right, Jaeg. No. 12 with +6. In June, *status idem*.

In the two foregoing cases the choroiditis was congenital and hereditary, but it was in no way identical with that of the father. I shall now relate a case in which both father and daughter had precisely the same form of choroiditis, that of the daughter being doubtless congenital.

Case 3.—*A.* Mr. B., merchant, middle aged, presented himself March 7th. 1871. Has been suffering for several years, but has no previous history to account for his trouble. Syphilis is denied, and there are no traces of it present.

The trouble had been increasing slowly, mostly in the *left* side, which was totally blind, while with the *right* he is able to continue his occupation. *Von Graefe*, and quite a number of his assistants, had been unable to arrest the disease of his eyes as well as relieve hemorrhoids, which the patient supposed to be connected with his eye disease. The following is the result of an examination made on the 14th of May, 1870, by *Dr. Leber*:—

Right. Snellen No. 5 easily, No. 3 with difficulty, and some words of No. 2 at 4" without a glass. Field of vision indistinct below, less indistinct inward, and not impaired either outward or upward.

Left. Counts fingers in $1\frac{1}{2}'$ and sees movements of hand in all directions.

Patient comes on account of an aggravation of symptoms. Functional examination shows: *right*, reads Jaeg. No. 9 at 4", field same as above; *left*, only quantitative perception of light. Physical examination discloses the following: first, remnants of iritis shown as thin synechiæ; second, choroiditis diffusa, with large patches of pigment as well as light spots seen over the whole fundus. Pigment is also distinctly seen lying upon the retina, which with the optic nerve is atro-

phic. Vessels are distinctly seen. Papilla pale, and borders ill defined. Constipation is now very annoying.

Treatment consisted in dietetic rules, aperients, and leeches ad anum, atropine and small doses of mercury, under which treatment the *left* eye returned to its former condition when examined last year.

On the 20th of August, read Jaeg. No. 5 and some words of No. 3 at 4". Visual field was very much contracted, and it appeared to patient as if he looked through a small hole.

B. His daughter, Meta, 18 years of age, suffers from blepharitis ciliaris, and upon examination of sight, *right* eye was found highly amblyopic. Upon being questioned she stated that the weakness of sight and the changes in the eye had already been detected by her family physician, unsuccessfully treated by *Von Graefe*, *Schelske*, and *Leber*. Functional examination shows *left* eye myopic, but capable of reading Jaeg. No. 1 with ease, with *right* she reads letters of No. 20 with difficulty, and counts fingers at 3'. There is no eccentric impairment of visual field.

The ophthalmoscope shows extensive changes, similar to those of her father: large patches of pigment, almost confluent, covering the greater part of the fundus. At the periphery are several smaller round patches of different shape and color, but similar to those found in *choroiditis areolaris*. Pigment in the retina covering the vessels can be distinctly seen.

No treatment was applicable to this condition.

II. CHOROIDITIS SPECIFICA.

It has been long known to most observers that many forms of choroiditis are of syphilitic origin, but to this source some have attached too much importance, whilst, on the other hand, others have underrated it. Literature contains but a few definite statements concerning this form of disease.

Von Graefe considers that form of *choroiditis disseminata* which is characterized by numerous white circumscribed patches surrounded by red zones, and

occurring in the posterior pole of the globe, as chiefly dependent upon syphilis.

Soelberg-Wells says, "I have also found this form of choroiditis more frequently associated with syphilis than any other, but yet it must be admitted that syphilis may assume the most varying appearances. Thus I have seen cases of syphilitic choroiditis in which a large bluish-gray exudation occupied the region of the yellow spot, and around this, to a considerable distance, were scattered numerous smaller patches of exudation."

Liebreich, in his *Ophthalmoscopic Atlas*, table IV., fig. 2, gives an excellent picture of atrophy of the retina in connection with choroiditis disseminata, and is of the opinion that choroiditis specifica is distinguished by small white shining patches surrounded by dark borders, with no tendency to coalesce.

Galezowski, in his paper on "Syphilitic Amblyopia and Amaurosis,"* describes one form with large black and white patches as "choroidite syphilitique disséminée," and says that in other subacute forms appearing with pain and circumcorneal injection there are numerous red patches with complete or incomplete pigment zones and white atrophic patches. "*Des taches nombreuses, ROSÉES, se forment sur plusieurs endroits de la choroïde, et à côté d'elles on remarque des amas pigmentaires en forme de ronds ou de cercles noirs, ainsi que des plaques BLANCHES de l'atrophie choroidienne.*"

Under the name "*choroido-rétinite syphilitique sans ou avec pigmentation*," he comprises the following symptoms:

* Archives Générales de Médecine, 1871.

1. "*Trouble ou perte de la vue arrivant par accès ou crises.*"

These attacks occur at varying intervals, leaving a haziness or cloudiness of vision.

2. *Nuage sous forme de toile d'araignée flottant constamment devant les yeux.*

3. *Photopsies très fréquentes.*

4. *Photophobie.*

5. *Héméralopie*, in the more advanced stages.

6. Concentric impairment of visual field, while central vision remains for a long time preserved.

7. "*Un des signes les plus constants : le trouble des milieux du fond de l'œil, qui fait voir la papille du nerf optique très nuageuse.*"

8. Atrophy of the vessels beginning at the periphery while the reddish color of the papilla is retained (in contradistinction to atrophy).

9. Retinitis pigmentosa at a later period of the disease (syphilis), mostly between six months and three years after infection. Sometimes (in 3 out of 63 cases) he found "*des taches blanches, rondes, disséminées çà et là, qui ne sont autres que des exsudations condylomateuses.*"

He considers *congenital retinitis pigmentosa* and *retinitis pigmentosa syphilitica* as identical, except that in the latter form the patches are of more varied hues. "*Les taches pigmentaires syphilitiques se déposent le long des vaisseaux rétinien, mais elles forment des amas circulaires, circonscrits, en forme de cercles d'herpès circonscrit.*"

Many authors lay great stress upon the location of

the changes in the choroid. Some consider those forms where the exudations occur in the posterior hemisphere in the vicinity of the macula lutea, so-called *choroiditis postica*, of a specific nature, whilst others, for instance *Maauthner*, consider it specific where there are numerous small patches in the region of the equator.

According to *Schweigger*, choroiditis syphilitica is characterized by very small, punctate, red, white, and black patches in the fundus, and he also adds, it will always be necessary to base the diagnosis not only upon the ophthalmoscopic appearances, but to prove the presence of syphilis by other means.

We think also that it is impossible to make the diagnosis of specific choroiditis by the ophthalmoscopic examination alone. Here as elsewhere, for instance in specific iritis, the law found by *Virchow* holds good, that syphilis gives rise to simple products of irritation as well as pathognomonic (gum-like) products.

In general, it is more important to notice the initial than the terminal alterations of choroiditis. We shall endeavor to illustrate by a few cases some of the more frequent forms of *choroiditis specifica*, and try to show how it can, with certainty, be diagnosed.

Case 1.—Mr. L. M., æt. 37, came to the clinic December 31st, 1870, on account of his left eye. The history, as given by his family physician, showed that four months previously he had an indurated ulcer upon the prepuce, followed seven weeks later by roseola, pharyngeal catarrh, and other unmistakable signs of syphilis. The treatment consisted in sublimate pills and Zittmann's decoction. During the last four weeks the sight of the *left eye*, which had been weak for

four years, has been getting worse. Photographs taken in former years showed that he then had divergent squint of the *left* eye. For the last nine days his sight has become worse, and he is troubled with coruscations. He was ordered iodide of potassium, extractions of blood with Heurteloup and a sparing diet.

Status præsens. Patient is robust, but shows marked symptoms of syphilis; mucous patches at the angles of his mouth, and a copper-colored syphilide upon the back of his neck. No albumen in urine. With the *left* eye he can only count fingers when held very close, and most readily when held near the outer half of the visual field. With the *right* he reads Jaeg. No. 1 with the aid of +40, and counts fingers, though with difficulty, in all parts of visual field.

The ophthalmoscopic examination shows a diffuse opacity of the left retina extending from the pale, opaque papilla, the vessels of which are veiled, to the periphery, where small patches can be seen in the choroid. The right retina appears unchanged in the centre as well as at the papilla, but at the periphery are numerous small and very delicate white atrophic patches. The patient was told that his right and seemingly good eye was in danger, and was accordingly admitted to the house and placed under our usual anti-syphilitic treatment (Sigmund's inunction: $\mathfrak{D}$ i. to $\mathfrak{Z}$ i. of blue ointment twice a day). At the same time a Heurteloup to left temple and rest in the dark were ordered. On January 7th, he unfortunately left on account of a severe attack of nostalgia. His sight was tried, and he read Jaeg. No. 1 with +36 with right eye, and with left counted fingers at $2\frac{1}{2}'$.

At home he employed a diaphoretic treatment, and on the 14th asked to be seen on account of his *right* eye, which had become worse. He said his *left* eye had greatly improved, but the coruscations before his *right* eye were very annoying, causing him to see all objects as if through a sieve or railing, or as if the sun was shining through dense foliage. He was examined by lamp-light, and with the *left* eye counted fingers at 6', and with the *right* read Jaeg. No. 12 with +6.

In indirect vision he saw the fingers everywhere, but noticed many small isolated defects in the visual field, the largest of which was situated downward and outward.

The *left* papilla is found less veiled, but still pale, and the vessels are seen more distinctly; in the *right* eye the retina is diffusely veiled

and there is marked venous hyperæmia. In the periphery *numerous small, round, snow-white patches* are seen, chiefly following the course of the retinal vessels, around which they cluster, resembling bunches of grapes. Though, they are situated behind the larger as well as medium-sized vessels, and are but slightly raised, they implicate the retina as well as the choroid. Besides these the patches above mentioned are scattered over the whole periphery of the posterior half of the globe, the most numerous in the inner and upper quadrant, in harmony with the defect in the visual field above described.

A rigorous inunction treatment was continued for two weeks, with several abstractions of blood by means of Heurteloup's leech, the patient being always kept in the dark. An examination on the 29th of January showed considerable improvement. With the *left* eye he counted fingers at 6'.

With the *right* he read fine print, and upon superficial examination the visual field appeared complete. The opacity of the retina had cleared up, *the milky-white patches of gummy choroiditis were transformed into small round circumscribed patches with irregular pigmented borders showing a delicate pink hue when compared with the old white shining atrophic patches.*

February 12th.—Reads fine print with *right* and medium-sized with *left*; coruscations have ceased, and he counts fingers eccentrically in every direction. In the *right* eye the papilla and adjacent portions of the retina are normal, and at the periphery the above described patches are still to be seen. *Left* papilla is clear but pale, with well-defined borders. February 26th.—Reads finest print with the *right* eye, and medium-sized with the *left*. Field of both eyes complete. The retina of the *right* eye appears perfectly clear, and the patches at the periphery are most numerous, inward and upward, and here also are to be seen some rosy patches surrounded by black pigmented edges. The optic nerve and retina of *left* eye are distinct, the former being pale. Slight changes in choroid are noticed at the periphery.

The patient took pills of biniodide of mercury and iodide of potassium alternately for several months, had Heurteloup's leech now and then applied, and kept his eyes at rest. Since that time he presented himself repeatedly with excellent sight in both eyes. The coruscations have ceased entirely, he reads finest type with both eyes,

with + 6, which, for the left eye especially, is a remarkably good result.

We have seldom an opportunity of following the whole course of this disease as in the preceding instance, but I can record some cases the earlier stages of which I observed.

Case 2.—Mr. W., a young merchant, came to the clinic on account of coruscations. He is myopic, uses —10, and reads, with difficulty, Sn. No. 2 with the *right* eye, and Sn. No. 3 with the *left* at 4". The ophthalmoscope shows: *Right*—hyperæmia of central vessels, the papilla veiled, and surrounding it, especially inward, are small, white choroidal patches. *Left*—the papilla more opaque, the opacity extending to the neighboring parts of the retina. There are also numerous stationary and floating opacities in the vitreous; many white patches lying behind the retina are spread over the whole fundus. He had an infection more than a year ago, and says he has been treated with large doses of mercury, but negligent as he was, he made his appearance only once again, and since then has not been seen.

Case 3.—Mr. D., merchant, æt. 23, came, August 12th, 1871, on account of weakness of his *left* eye. With the *left* read Jaeg. No. 8 at 6" and Sn. LXX. at 15', concave glasses not improving the sight. With the *right* eye read Jaeg. No. 1 at 8", Sn. XL. at 15', with —24, and Sn. XX. at 15'. Interior normal.

In the left are floating opacities in the vitreous, there is a slight diffuse opacity radiating from the papilla, and at the periphery are numerous small, distinct, white patches of various sizes, apparently of long standing, but without pigmented borders. They show no tendency to coalesce like similar patches in simple as well as tuberculous choroiditis, although in places they lie very close together.

The *history* is: He had an ulcer upon the genital organs six years ago, eruption over body and enlargement of the glands. He was told the cause of his eye-disease and the proper treatment; nevertheless he did not return until Oct. 17th. Meanwhile he had been placed upon an expectant treatment by a physician, who said his eye-disease was not of a syphilitic nature; but the left eye becoming worse, our patient

lost faith and returned. October 17th.—*Right* eye the same as when previously examined. With *left* can hardly count fingers when held close by. Ophthalmoscopic appearance the same as when first examined, infiltration of retina more pronounced, and papilla looks paler. (Compare Case 1.)

Inunction was persistently employed, and marked improvement ensued.

November 7th.—Reads Jaeg. No. 5 with the *left* eye, field complete. There are still delicate membranes in the vitreous, infiltration of the retina, and gummata of the choroid. The after-treatment consisted of pills of corrosive sublimate, iodide of potassium, Heurteloup and seton. Patient did not rest his eyes as directed, and consequently there was a relapse. January, 1872, so that he could only count fingers at the distance of a few feet. Inunction was repeated with benefit.

Case 4.—Anna K., æt. 33, presented herself March 13th, 1871, on account of weakness of sight and glimmering. With +6 she could read Sn. 11 in 4" with the *right* eye and Sn. 3 at 4" with the *left*.

In the *right* eye are remnants of iritis, from which she had suffered a few months previously. Floating opacities in the vitreous, diffuse dense infiltration of the retina, and small, punctate, roundish, gray patches at the periphery of the choroid. In the *left* eye there are neither opacities in the vitreous, nor infiltration in the retina, nor small choroidal patches. Atropine was instilled into right eye, and inunctions commenced. April 20th.—She could, with +6, read, *left*, Sn. 2, *right*, Sn. 5. June 21st.—*Left*, Sn. 2 at 12" with difficulty without lens, *right*, with +6, Sn. 19. June 28th.—*Left*, status idem, *right*, with +6, Sn. 14 with difficulty. July 6th.—*Left*, status idem, *right*, with +6, Sn. 11 with difficulty. Iodide of potassium now used, with abstractions of blood by Heurteloup, all of which treatment improved her sight. July 19th.—*Left*, Sn. 2 at 12" without any glass, *right*, with +6, Sn. 6 at 4". August 11th.—*Left*, status idem, *right*, with +6, Sn. 8 with difficulty. Ophthalmoscopic appearances the same. Sublimate pills given. August 18th.—*Left*, status idem, *right*, with +6, some small words of Sn. 6. September 19th.—*Left*, status idem, *right*, with +6, Sn. 11. October 11th.—*Left*, status idem, *right*, with +6, Sn. 8, and letters of Sn. 5. November 2d.—*Left*, status idem, *right*, with +6, Sn. 11, Sn. 6, and small words of Sn. 5.

The most frequent form of choroiditis specifica is that which shows small non-coalescent patches, having the maximum size of a pea.

Their color, depending altogether upon the stage of the disease, varies from a delicate white or rosy hue to a snow white. They may be completely or only partially surrounded by pigment zones. The retina is always implicated. The papilla is veiled, and the adjacent retina opaque and swollen, especially along the course of the vessels, so that the disease may fairly be called *chorio-retinitis*. The vitreous body manifests its participation by delicate flaky or membranous opacities. In some cases the anterior portion of the uveal tract participates in the inflammation, and iritis, with formation of posterior synechiæ, supervenes.

The *nature* of the disease is chronic, and relapses are frequent. Its *prognosis* appears more favorable than in the non-specific variety. To trace its course and termination, and give an accurate description of its different stages and their treatment, a larger number of cases should be at our disposal.

The *treatment* must be anti-specific: Inunctions in the acute stage, followed by sublimate and iodide of potassium; restriction of diet, with occasional abstractions of blood by Heurteloup's artificial leech; complete rest of the eyes.

SARCOMA OF THE IRIS.

BY DR. ARGYLL ROBERTSON, OF EDINBURGH.

AND

DR. H. KNAPP, OF NEW YORK.*

(See Table D.)

CATHERINE POW, aged 24 years, was admitted to the Ophthalmic wards of the Royal Infirmary, Edinburgh, on June 29th, 1871. She states that she enjoyed good health, and did not notice anything peculiar in her sight or eyes till 14 months ago, when she had a slight inflammation in the right eye, unattended by pain, and only of short duration. At that time she also noticed that the gas-flame appeared red when both eyes were open, but she did not test the eyes separately; in other respects she did not then notice any alteration in vision. Six months later she had severe pain in the right eyebrow and temple, increased by exercise, and during night, and attended by dimness of vision whenever she attempted reading or sewing. These attacks of pain lasted for two or three weeks. About six months ago she had a slight inflammation in her left eye (apparently conjunctival), and her medical adviser directed it to be bound up, when she for the first time noticed that her vision in the right eye was very dim, so that she could not see to guide herself with it. She also noticed that the right pupil was larger than the left, and that when the left eye was closed the gas-flame appeared red, and that the light of the sun was of a yellow tint. She never experienced any photopsiæ or muscæ before the eyes. During the last two months she has suffered from pricking pains in the right eye during the night, at intervals of three or four nights, but which are not so severe as to prevent sleep. The family history is good.

Towards the end of April, 1871, she first applied to me for advice.

* The history of this remarkable case is by Dr. A. R., the description of the specimen by Dr. H. K.

I then observed that the right pupil was more dilated than the left and acted very sluggishly under the influence of light, that there was a grayish reflection from the pupil, that the right iris was somewhat discolored, and that at *its upper and outer ciliary margin there was a small light-brown tumor about 1" in length and $\frac{1}{2}$ " in breadth*. Vision was restricted to the counting of fingers held close before the eye. There was distinct glaucomatous cupping of the optic nerve, but no retinal pulsation visible. The tension also was markedly increased. From the very small size of the tumor of the iris, I thought that the glaucomatous symptoms might be idiopathic and not due to its growth, and I therefore recommended the performance of an iridectomy. The patient, however, would not submit to the operation, and went home to the country.

State on admission, two months later. The patient is a healthy-looking, moderately robust young woman, of light complexion.

Left eye. Iris bluish gray, pupil active and of medium size. Vision normal ($V. = \frac{20}{20}$); tension normal. On ophthalmoscopic examination, *physiological* cupping of the optic nerve is observed, occupying about half of the diameter of the disk. The disk itself is slightly oval—the fundus in other respects quite natural.

Right eye. The iris is of a somewhat darker hue than the left (slate-colored). The pupil, which has just been dilated by atropine (but which was previously observed to be larger than the left and immovable), measures $3\frac{1}{2}'$ in diameter. In the upper and outer part of the iris and at its junction with the ciliary ligament is an oval, brownish tumor measuring $1\frac{3}{4}''$ in length by $1''$ in breadth, and extending downwards from this tumor, keeping to the ciliary margin of the iris, there is a chain of three other similar tumors of very small size (about $\frac{1}{2}''$ in diameter). A plexus of subconjunctival veins extends from near the margin of the cornea towards the periphery. These become much injected after slight pressure on the eye. The patient can, I believe, distinguish bright light from darkness, but her statements were so contradictory that it was difficult to arrive at a correct conclusion. The tension of the eye is very markedly increased ($T+2$). The ophthalmoscope revealed deep glaucomatous cupping of the optic nerve, with pulsation in the central retinal artery. In other respects the fundus appeared perfectly healthy. No tenderness was exhibited on pres-

sure over different parts of the eye. Neither oblique illumination nor ophthalmoscopic examination revealed any affection of the most peripheral portions of the choroid.

From the increase in size of the original tumor and the development of several new growths, the case was viewed as one of melanotic sarcoma inducing glaucomatous symptoms. Dr. Knapp, of New York, who kindly examined the case, was of the same opinion. The patient was urged to submit to the removal of the eye without delay, to which she consented after having obtained the permission of her parents.

The eye was removed on July 4th, by the usual method. The cut extremity of the nerve presenting a dark color, an additional small piece of nerve was removed. About five minutes after removal, on placing the eye into a bottle containing Müller's fluid, I observed that the previously dilated pupil had contracted to medium size, and ten minutes later, on looking at it in the fluid, I observed the pupil to be much contracted. The eye and portion of nerve removed were set aside for transmission to Dr. Knapp for examination.

On July 8th the conjunctival wound was completely healed, and the patient left the Infirmary (the suture was removed the day before).

I saw the patient in April, 1873. She appeared in excellent health, and the contents of the orbit were free from disease. She wore an artificial eye. I had a letter from her in June, 1873, that is, two years after the operation, in which she stated that she continued in good health, and there were no signs of any return of the disease.

Anatomical Examination.

The eye, perfectly hardened, was opened by a circular section in the equatorial plane. The coagulated vitreous showed under the microscope a finely-dotted and striated basis-substance, in which there were embedded small cells with distinct nuclei surrounded by protoplasm branching in irregular offsets—amœboid cells; furthermore, large stellate cells anastomosing with one another

—fixed cells; and long curved threads and bands which had irregular outlines and were studded with black dots. This condition is the anatomical expression of what is ophthalmoscopically diagnosticated as “diffuse and formed opacities of the vitreous body.” After careful removal of the gelatinized vitreous humor, the inner surface of the posterior half of the globe—the fundus oculi—disclosed a marked cup-like depression at the entrance of the optic nerve—glaucomatous excavation—but no other abnormality. The anterior parts of the walls of the vitreous chamber, viz., ciliary body, suspensory ligament, and posterior capsule of the lens, were likewise normal. I then detached the ciliary body, iris, and lens from the sclerotic, in order to obtain an unobstructed view of the front surface of the iris, the outer surface of the ciliary ligament, and the pars non plicata of the ciliary processes (Fig. 1, Tab. D). The front surface of the iris was dull, grayish-blue. On it were seen a great number of minute roundish elevations (Fig. 1, *a*), two or three somewhat larger nodules (*b*), and a brownish hemispherical tumor the size of a pea (*c*), situated at a small distance from the insertion of the iris. Looked at with a low power of the microscope by incident light, the elevations and intumescences dissolved into clusters of small roundish or irregular nodules, with a yellowish, glassy-looking, and granular surface (Fig. 2, *a*). Near the inner boundary of the larger iris-zone the same substance was more diffusely spread over the anterior face of the iris (Fig. 2, *b c*). The surface of the larger tumor (Fig. 1, *c*) was somewhat uneven and finely granular.

Transverse sections of the iris (Fig. 3, Tab. D), when

examined with a low magnifying power, showed the posterior (*p*) (uveal) and middle (*m*) (stroma) layers unchanged, but the anterior layer (*a*) thickened, and studded with small oblong (*d*) and round (*b*) tumors. The sphincter pupillæ muscle (*s*) was normal. The tumors were the clusters and diffuse thickening which we observed on examining the front surface of the iris by incident light (Fig. 2). Sections through the centre of the larger tumor (Fig. 4, Tab. D), disclosed a uniform, cellular, extremely vascular texture in immediate connection with the uvea. Numerous pigment-cells were seen in some portions of the tumor (*p*). Sections through the periphery of the large tumor showed a thickening of the anterior layer of the iris like that which we have noticed in the small nodules.

The structure of all the tumors, when examined with high powers, consisted of densely crowded small cells or nuclei surrounded by scant protoplasm, embedded in a homogeneous matrix (Figs. 5, 6, 7: the cluster of cells on Tab. D, designated Fig. 6 $\frac{8.0.0}{1.0}$, should be Fig. 5 $\frac{8.0.0}{1.0}$). The cells were finely granular and had distinct, shining nucleoli. At the edges of thin preparations (Fig. 6, *a*) many cells were spindle-shaped, but where they lay more densely above one another (Fig. 5, and Fig. 6, *b*), only the round and oval forms of the nuclei were conspicuous. I should state that the round cellular elements were prevalent on the edges as well as throughout the whole extent of the majority of the preparations, however thin they were made. The neoplastic elementary parts, in most places, were separated from the stroma of the iris by an ill-defined line of demar-

cation (*c*, Fig. 6), but where they formed larger tumors (Fig. 4), the middle layer of the iris had disappeared, and the pseudoplasm was in immediate contact with the pigment stratum. The stroma of the iris was normal in many places; in others, however, more or less infiltrated with and replaced by nuclei and small cells, resembling those of the pseudoplasm. The *blood-vessels* of the tumor (Fig. 4, *v*) were not only very numerous, but uncommonly large. They anastomosed freely. Their walls were thin and delicate (Fig. 7, *v*), consisting only of one homogeneous, transparent layer. It was not possible to distinguish between arteries, veins, and capillaries. The *pigment*, which was exceedingly scant in the smaller nodules, but conspicuous in some places of the larger tumor, was found in isolated granules (Fig. 6, *g*), in clusters of small disks (Fig. 7, *d*), and in round or irregular forms (Fig. 7, *e*). Apart from the iris, all the other coats of the eye were found normal.

As to the *nature* of the disease exhibited by the specimen under consideration, we cannot hesitate to pronounce it a *melanotic sarcoma of the iris*. Not mentioning the rarity of such tumors in general, the case above described shows some features of particular interest, especially the development of the pseudoplasm from the anterior layer of the iris, and the great number of small tumors. The anterior layer of the iris consists of a matrix of fine connective-tissue fibres in which numerous nuclei and cells are embedded. A single layer of epithelial cells covers this stratum in children, but is absent in the adult. The front surface of the iris is lined by a dense and very delicate network of connective tissue.

I take this description from J. HENLE's text-book of anatomy, because it corresponds with what I have seen myself, but should not forget to mention that G. SCHWALBE states that the anterior epithelium ("endothelium of the anterior surface of the iris") is of constant occurrence. The pseudoplasms in the specimen under consideration not only originated in this anterior layer of the iris, but had a very similar structure. They may, therefore, be considered as homologous formations. The scant and delicate intercellular substance, the dense accumulation of the nuclei and round cells, and their development into spindle-shaped formations, characterize the nature of the growth as sarcomatous.

The question is whether the single isolated tumors were the result of a common morbid tendency in this iris, or the product of dissemination from the primary (larger) tumor? The location of the larger tumor in the upper part of the iris and the denser accumulation of the smaller tumors in the lower part seem to support the dissemination hypothesis. Small particles of the larger tumor may have been detached, suspended in the aqueous humor, and, by gravitation, settled upon the lower part of the iris. This process would be analogous to the punctate depositions on the walls of the anterior chamber in serous iritis. I examined the posterior face of the cornea and the anterior capsule of the lens, but found them free from depositions. Though this seems to be an argument against the propagation of the pseudoplasm by dissemination, it does not positively exclude it, for it seems natural that elementary parts of the type of connective tissue, when sown on

different organs, may take root in a tissue of the same nature, whereas they may perish on a heterologous tissue.

To what cause the primary tumor owed its origin cannot be ascertained. That a propagation by uninterrupted lateral extension took place in our specimen, is demonstrated by the diffuse accumulation of the pseudoplasm near the minor zone of the iris.

The former view, that a morbid tendency towards the generation of this neoplasm may have existed in the iris, is not without analogy either, for isolated melanotic tumors are sometimes observed over the whole body. A few years ago I saw such a case, which was under the care of Dr. *F. Simrock*, of New York. Melanotic sarcomatous tumors were scattered over the whole skin of the patient; besides, they were found in the iris and choroid of both eyes, and in the parenchymatous organs when the patient died. Which of these two views has the greater probability, I am unable to tell.

There is only one case of melano-sarcoma of the iris on record (*Arch. f. Ophthalm.*, Bd. XIV. No. 3, p. 285, etc.). It was that of a farmer, 38 years of age, who in May, 1868, came under the care of Prof. *A. von Graefe*. The lower half of the iris was occupied by a brown tumor, which in the course of a year had developed from a congenital brown speck in the iris. S. normal; F. complete. Von Graefe diagnosticated a malignant growth, and removed the eye. The specimen was examined and described (*l. c.*) by *F. Hirschberg*. It was a very vascular spindle-celled melano-sarcoma, starting probably from the anterior layers of

the iris, as healthy iris-stroma was situated behind the peripheric portions of the tumor.

The case of Dr. *A. Robertson* differs from that of Von Graefe essentially: there were many small tumors, and the eye had become glaucomatous, which shows that the tumors of the iris follow the same clinical course as those of the ciliary body, choroid, and retina, viz., no irritation in the first stage, glaucoma in the second.

The growth was malignant, showing a multitude of smaller tumors, all ill-defined and consisting of a dense agglomeration of small cells with very scant intercellular substance, besides their being well supplied with large thin-walled blood-vessels.

Removal of the whole iris—which is not a difficult or hazardous operation—might have been sufficient in this case, since all the other coats of the eye were found healthy. Yet this could not have been determined prior to the enucleation of the globe, which operation was so much the more justifiable as the eye had already been blind.

The *prognosis quoad vitam* was considered favorable, as the disease, though malignant in its nature, was still limited. The freedom from a local relapse and from affections of remote organs up to this time, two years after the operation, seems to confirm this view.

INTRA-OCULAR HEMORRHAGE WITH FORMATION OF AMYLOID BODIES IN THE EXTRAVASATED BLOOD AND AMYLOID DEGENERATION OF THE CHOROIDAL ARTERIES.

By H. KNAPP.

(See Figs. 2—5, Tab. E.)

MR. AUGUSTUS S., 42 years of age, consulted me on 31st October, 1872. He said that a few days previously, after a night passed in gay society, with dancing, drinking, and smoking, he first noticed slight uneasiness and nearly total loss of sight in his left eye. As it had not changed, he came for advice. I found the tension of both eyes normal, in the right H. = $\frac{1}{8}$; S. $\frac{2}{10}$; fundus, etc., normal. In the left there was slight circumcorneal injection, the iris discolored, the pupil dull. With the ophthalmoscope only the upper inner portion of the fundus could be illuminated; the remainder appeared completely dark. With oblique light the lens proved to be transparent, the vitreous chamber showed no details, except a reddish reflex in its lowest part. He saw only movements of the hand in the lower-outer part of the field of vision. The patient was pale, but hearty and strong. I diagnosticated intra-ocular hemorrhage, ordered leeches to the temple, rest in bed, atropine instillations, and the so-called hemorrhoidal powder (rheum, cremor tartari, magnesia carb., flor. sulph. and sugar). The circumcorneal injection and faint tenderness soon disappeared, but his sight diminished, so that movements of the hand were seen only in the centre of the visual field, whereas a candle was seen throughout. Four weeks after I first saw him, the tension of the eyeball was still normal, the light of a candle was perceived in all parts of the visual field, there was no irritation in the eye. Examined with oblique light, the vitreous chamber showed everywhere a dirty brown reflex, as if it were completely

filled with a dark-brown substance which reached as far as the posterior capsule of the lens. Its color was uniform ; no blood-vessels or details of any kind could be detected. It was as if one looked into a thick, dark-brown mist.

The *diagnosis* of this case embarrassed me. After a night passed in merry-making, one eye, which had never before been thought to be diseased or deficient in sight, was almost totally blind, somewhat painful, and slightly inflamed. The dark appearance of the fundus on ophthalmoscopic examination rendered the existence of hemorrhage into the vitreous chamber probable, and the red mass, seen at the bottom of the vitreous by oblique illumination, made it certain. The course of the disease seemed, however, to differ from that of simple hemorrhage. Instead of clearing up while the symptoms of irritation disappeared, it became darker and assumed a blackish-brown color. I thought that a melanotic tumor was at the bottom of the difficulty, and that the excitement of a restless night had caused the hemorrhage, which is known to be a frequent occurrence during the growth of intra-ocular sarcomata. The absence of increased tension in the eyeball, and the preservation of faint perception of light in all parts of the visual field, on the other hand, made me strongly doubt the correctness of my supposition. The tumor, indeed, might have been situated in the ciliary region, and thus occasioned no defect in the visual field ; but ciliary sarcomata hardly ever escape being detected when examined with concentrated light, and I was unable to discover any traces of such a tumor. If situated in the choroid proper, the pseudoplasm might

have been so small, and the retina have preserved its natural position and integrity so well, that perception of light was still possible. Even if that portion of the retina which covered the tumor had lost its faculty of perception, it was possible to imagine that the opacities in the vitreous body diffused the light so as to hinder the detection of a limited defect in the visual field. A detachment of the retina, on account of the preserved perception of light, had to be excluded; but we know that in the early stage of choroidal sarcomata the retina, as a rule, is not detached. In spite of this reasoning, the absence of positive symptoms of a tumor impressed me with so much doubt in regard to the diagnosis, that I requested the patient to have his eye examined by some other eye-surgeons.

He consulted Drs. H. D. Noyes and H. Althof. Both diagnosed a melanotic tumor, and advised the removal of the eye without delay.

Supported by their opinions, I enucleated the eye, Dec. 2, 1872, nearly five weeks after it had become affected. The operation and healing were without accident.

I opened the eyeball, by a meridional section, immediately after its removal. The whole vitreous space was filled with a very soft, perfectly black mass, which, at first sight, impressed me with the idea that the disease was a melanotic pseudoplasma of very soft consistence. Originating in the choroid, it might have perforated that membrane and the retina, and proliferated in the vitreous chamber until it filled it completely. I laid the specimen in Müller's fluid. When it was hardened, a careful examination disclosed an *entirely different dis-*

case. The soft contents of the vitreous chamber had shrunk considerably; the retina and choroid were everywhere in their normal positions, and no trace of a tumor was found. Between the choroid and sclerotic were seen collections of a dark-red, almost black substance of a granular appearance. It could readily be broken up with a probe, and resembled an old accumulation of blood, a supposition which was confirmed by the microscope. Similar but smaller accumulations were found between the choroid and retina. The blackish substance in the vitreous chamber was more coherent, yet so friable that only small pieces of it could be taken up with the forceps. Under the microscope they consisted of red blood-corpuscles and round, hyaline bodies, varying in size from the diameter of a white blood-cell to twice or three times as much (Fig. 2, Tab. E.). The majority of them showed no membrane, no striation, no nucleus, but were perfectly homogeneous. Some, however (*a*, Fig. 2), had a dark centre, in shape like a red blood-corpuscle, somewhat shrivelled. In some places these hyaline globules prevailed considerably over the blood-corpuscles; in others, especially in the masses between the choroid and sclerotic, they were scant, whereas the blood-corpuscles were abundant. They remained unchanged on addition of acetic acid, ether, and alcohol, but were colored intensely brown-red, like old polished mahogany wood, by tincture of iodine, which tinted the blood-corpuscles only slightly yellow. Addition of sulphuric acid rendered the hyaline globules violet. These reactions proved that they were *amyloid bodies*. Prof. N. FRIEDREICH

of Heidelberg first (1855) described their occurrence in extravasations of blood in the lungs and the tunica vaginalis scroti—hæmatocele. He had the lardaceous substance of a spleen analyzed by Prof. Kékulé, who found it identical with albumen and fibrin (see Virchow's Archives, vols. IX., X., XVI.). The amyloid formation in our case once recognized, I carefully examined the blood-vessels of the extirpated eye, and found that the arteries of the choroid gave the characteristic iodine reaction in their inner and middle coats. The capillaries were unaffected. The arteries appeared, under low magnifying power, as markedly brown-red stripes. Under a higher power the inner and middle coats only were seen red, the outer uncolored (Figs. 3 and 4, Tab. E.). The red coloring was homogeneous, but in it were seen numerous small cells which exceeded only little the size of white blood-corpuscles, and were placed in a dense row near the inner margin of the vessel (*b*, Figs. 3 and 4, Tab. E.). The calibre of the arteries was much reduced, that of many veins (*c*, Fig. 4) considerably enlarged. The capillary layer (*d*, Fig. 4) appeared unchanged in some places; in others it was the seat of extensive hemorrhage (Fig. 5). The capillaries were distended, choked with blood, and the extravasations were proofs of their ruptures.

Lardaceous degeneration or infiltration being considered not as a local but a general disease, I examined the general health of the patient repeatedly, the last time June 21, 1873, but could not detect any abnormality. He looked healthy, was vigorous, and regular in all his functions. He never had had a syphilitic affection,

nor a malarial disease, nor suppuration of the bones, and has never been intemperate. His children are healthy. His urine appears normal, is secreted in normal quantity, and contains neither albumen nor sugar. His heart, spleen, liver, and kidneys do not show any abnormality on physical examination. His other eye is hyperopic, but has perfect sight, and appears normal on physical examination. I shall, however, watch the patient with reference to symptoms of lardaceous disease in other organs.

Clinically, this case is important. Amyloid formation in the eye has not yet been described. The sudden appearance of the affection, the darkness of the fundus on ophthalmoscopic examination, and the red lustre from the bottom of the eye on focal illumination, are sufficient for the diagnosis of hemorrhage into the vitreous chamber. If, then, instead of clearing up and showing diffuse and floating opacities in the vitreous body, the vitreous chamber appears dark, dirty brown, without any details, the dark cobweb-like opacity reaching to the posterior surface of the lens, perception of light being preserved in the whole field of vision, and the tension of the globe not, or not markedly, increased, we should exclude the presence of an intra-ocular tumor and detachment of the retina, and think of the possibility of intra-ocular hemorrhage with formation of amyloid bodies. This supposition gains in probability when some of the general symptoms or causes of amyloid disease are present: intemperance, lues, chronic suppurative affections, especially of the bones, or some cachexia from any cause.

The treatment should be according to the general health. Removal of the eyeball could only be recommended in cases of doubt. I am unable to foretell what inconveniences or bad consequences an eyeball affected with amyloid degeneration is likely to produce if left in place. Recovery of sight seems impossible.

Concerning the *pathogenesis* in this case, it appears most plausible that the lardaceous infiltration of the choroidal arteries, on account of the narrowing of their calibre and diseased condition of their walls, was the remote cause of the hemorrhage, the immediate cause being the disturbance of circulation resulting from the excitement of a night passed in excessive bodily exercise, and the free use of stimulants.

In order to detect the mode and mechanism of the hemorrhage, I examined larger portions of the choroid and found the following conditions: The walls of the arteries were thickened and their calibre was reduced by the waxy infiltration. The veins, not participating in the infiltration, were enormously dilated; some of them were filled with blood, but the majority were empty. The capillaries were distended and choked with blood, and many of them were ruptured. The hemorrhages originated nearly all in the capillary layer. The inner strata of the choroid, in many places, were densely infiltrated with blood-corpuscles, which in long streaks made their way inward between the choroid and retina and into the vitreous space. The narrowing of the arteries and the degeneration of their endothelium and the muscular coat must have offered a great resistance to the arterial current, and as a consequence

have greatly reduced the intra-vascular pressure in the capillaries and veins, the vis-a-tergo of the arterial current being exhausted by the uneven and narrowed calibre and the inelasticity of the walls of the arteries. The blood which was forced through the narrowed arterial tubes, was at once received in a multitude of comparatively wide and extremely thin-walled capillaries and wide veins. The force of the current, already greatly diminished by the resistance in the degenerated arteries, was now distributed over the immense space of the capillaries and veins of the choroid, by which it must have been reduced almost to a minimum. Stagnation was the immediate consequence. Stagnating blood must soon lose its nutritive power, on account of which the walls of the vessels become diseased, softened, and frail. If now in some veins stasis by coagulation or over-distension takes place, and the corresponding arteries continue to pour in, even never so little, blood, a rupture of the capillaries, the weakest link in the chain, must take place. The veins are then free from any intra-vascular pressure, no fresh blood being forced in. The elasticity of their walls is the only active force remaining, and its effect must be the evacuation of the contents of the venous tube towards the heart, facilitated by the aspiration of the neighboring venous vessels; in part, however, the veins may empty their blood also into the ruptured capillaries. This seems to account in a satisfactory manner for the conditions found in the case under consideration: narrowing of the arteries, engorgement and ruptures of the capillaries, hemorrhages, dilatation and emptiness of

the veins. The dilatation of the veins must have taken place when both capillaries and veins were overfilled with blood, a stage preliminary to the capillary hemorrhages.

I have yet to add that these morbid conditions extended over, and were limited to, the choroid proper. Ciliary processes, iris, and retina showed no traces of amyloid infiltration.

Bearing in mind that amyloid disease is not known to be limited to one organ, I, of course, warned the patient against all conditions which are liable to produce it and were mentioned above. We should, however, remember that lardaceous disease has hitherto been found in the dead-house only, where, of course, we can but expect to see cases in advanced and generalized conditions of this disease. If, therefore, our knowledge of the general pathology of lardaceous disease would lead us to frame an unfavorable prognosis concerning the life of our patient, we could not do it without great reserve considering the apparent limitation of the affection to the choroid of one eye, the absence of any cachexia, and the scantiness of our clinical knowledge of this disease.

GALVANO-CAUTERY IN OPHTHALMIC SURGERY.

BY DR. J. SAMELSOHN, OF COLOGNE.

(Translated by T. R. Pooley, of New York.)

THE introduction of a new method into surgical therapeutics, or the extending of one already known into new fields, is only justifiable under the following conditions :—

1. That it must, at least, answer the same purpose as these approved methods have done.

2. Its application must be as practicable as that which is already known, and which has been used with success. If a new method fulfils these two conditions, then we are not justified in discouraging the efforts which others may make for its introduction; if, however, it does more, and gives for certain cases simpler, safer, and less dangerous surgical manipulations than those hitherto known, then it becomes our duty to use all our endeavors for its propagation.

Considered from this stand-point, galvano-cautery, first systematically employed by MIDDELDORPF, has won a decided claim to the consideration of practitioners. During the lifetime of its advocate it was only exceptionally, and we may say as a scientific complement, employed in the clinics. Since Middeldorpf's death, however, it has gained a wider extension—as if the

generalizing tendency of the discoverer had delayed the growth of its individual germs.

To-day it has become a specialty not only in the hands of ALTHAUS, BRUNS, and others, but it is also used by many practitioners as a not unwelcome supplement to surgical appliances.

Some of the specialties, such as otology and laryngosurgery, have adopted it, and it is therefore astonishing that the otherwise progressive specialty of ophthalmology has not become more familiar with its use. In order, therefore, to encourage a more extensive application of this method, it does not seem superfluous to publish my experience of five years in the application of this convenient agent for special ophthalmological purposes. It is not my intention to give an exhaustive explanation of the general method; this has already been done in the works of Middeldorpf, Bruns, Groh, etc. I shall only describe, in a simple and truthful manner, how and where I have tried galvano-cautery, and where it has proved to me a most welcome means of treatment after all others had failed.

The apparatus of which I make use is very simple, cheap, and easy to manage. It consists of three small zinc-carbon elements, which are connected by copper wires in the form of a chain. The glass vessels are common tumblers; the zinc cylinders of a corresponding size; the carbon plates $4\frac{1}{2}$ " long, $1\frac{1}{2}$ " wide, and $\frac{1}{4}$ " thick. These elements are filled by an assistant in the yard, so that the disagreeable vapors from the nitrous acid cannot enter my consultation room. Two flat copper wires connected with the elements lead from the yard across

the window-ledge into my room, and are fastened upon the ledge by rivets, and finally by clamp-screws.* The long, thin conducting copper wire, covered with india-rubber, fits into these clamp-screws, and is then connected with the handle. This handle contains a contrivance similar to the button-shaped handle described by Von Bruns† for closing and opening the current. Two wooden plates are riveted together, between which pass the copper wires with the current-breaker, admitting at any time of the discovery of the possible cause of an interruption of the current.

On each side brass tubes with thumb-screws are attached, into which fit, on one side the conductors, on the other side different connecting pieces. The latter consist of two twisted copper wires, covered with silk, flattened and perforated at one end, to which fine platina wires are fastened. The apparatus is charged and used according to the usual rules.

For such cases as we are about to describe, requiring only a transient glowing of the platina wire, the compendious apparatus just alluded to will answer every purpose. It gives enough electro-motor power, a current sufficiently constant for the short duration required, and relieves the practitioner from the painstaking care which more complicated apparatuses demand.

Let us now consider those cases in which I prefer galvano-cautery to all other means of treatment, and to

* Latterly I employ two Grenet-Stöherer elements filled with bichromate of potash and dilute sulphuric acid. The lack of constancy of this combination is no disadvantage for our purposes on account of the short duration of the current.

† V. Bruns : *Die Galvano-Chirurgie*, 1871, p. 34, Fig. 15.

which I apply it from the first. Here stands in the front rank—

1. *The closing of Lachrymal Fistulæ.*

The latest text-books on ophthalmology speak of the great facility with which lachrymal fistulæ, caused either by operation or spontaneous opening of a dacryocystitis suppurativa, close of themselves, or by the most simple treatment, as soon as the passage through the ductus naso-lachrymalis has become free.

Wecker goes so far as to assert,* “that every lachrymal fistula will close in the course of a few days, when we establish a wide communication between the lachrymal and the conjunctival sac, by incision of the ligamentum palpebrale internum. Observation of some years, both in clinical and private practice, has, however, taught me that in spite of perfect restoration of the communication of the lachrymal sac with the nasal duct, as well as with the canaliculis lacrymales, old fistulæ of the sac with callous edges remain open, and obstinately resist the usual methods employed to close them. Especially obstinate appear to me the so-called capillary fistulæ, the almost imperceptible openings of which give issue to a mucous fluid only after pressure on the sac. Here it seems, at first sight, as though a closure might easily be attained, and yet the usual methods of cauterizing generally fail. Even the refreshing of the whole fistulous tract, with or without the introduction of a suture, does not always succeed.

The principal cause of the difficulty of healing ap-

* *Traité des Maladies des Yeux* ; deuxième édition, tome premier, p. 910.

pears to be, that the exterior opening of the fistula is not on a level with the interior opening, and as the neighboring sclerosed tissue does not easily give way, the canal is more or less bent.

These curves, and sometimes angles even, are caused by the inflammation and subsequent contraction of the sac, resulting in a displacement of the inner opening, usually upwards. On account of these anomalous curves of the fistula, the cautery, although it be very thin, can with difficulty be made to follow them; even if we use a fine silver probe coated with argenteum nitricum, the cauterizing agent, exhausted by solution at the beginning of the canal, can have no effect upon its deeper parts, although the probe should reach them.

I have often succeeded in closing the exterior opening of the fistula for a short time, but the thin cicatrix would soon open again when a somewhat rough pressure upon the sac forced its contents into the open inner portion of the fistula.

If the canal of the fistula is wide, and has a large granulating external opening, the ordinary caustic can be more efficaciously applied throughout the entire extent of the canal. As, however, it is impossible to limit the action of the caustic to the fistulous canal, the operation may result in partial obliteration of the sac—an operation which has justly lost more and more the approbation of the profession. Galvano-cautery combines all the advantages of a thin cautery which adapts itself to all the windings of the canal, is of equal intensity everywhere, and can be accurately localized. Even the ob-

jection which at once arises, that the radiating and conducted heat may cause disagreeable inflammations in the adjacent parts, loses its force when we take into consideration the small surface of the glowing wire. In fact, I have never seen galvano-cautery followed by such phlegmons as are not infrequently met with after the use of the actual cautery.

The mode of applying galvano-cautery is as follows : After the passage through the nose has been made free, a sound, which as nearly as possible fills the duct, is introduced so as to be closely in contact with the anterior wall of the sac (usually Bowman, No. 6). Then the thin platina wire is by turning movements introduced cold through the external opening into the fistulous passage, until its point touches the sound in the lachrymal sac. As soon as, by pressing on the button of the handle, we close the chain, a slight scream of the patient, a burning smell, and the escape of hissing smoke, indicate the glowing of the wire. By removing the finger from the button which opens the chain, the wire immediately cools, and is then withdrawn. The pain ceases at once, and the removal of Bowman's probe terminates the operation.

I have never seen obliteration of the lachrymal sac following this operation. On the contrary, only after closure of the fistula a sufficient improvement of the diseased mucous membrane was obtained, as only then the blennorrhœic membrane could be touched on all sides by astringents. The scar resulting from the operation is so slight, that it does not cause any eversion of the inferior lachrymal point.

After the operation of fistulæ of the lachrymal sac, naturally follows—

2. *The Operation of Obliteration of the Lachrymal Sac.*

Although this operation, to some extent, has justly fallen into disuse, in some cases it is unavoidable. In such cases Wecker* warmly recommends galvano-cautery, and I suppose that many practitioners have followed his good advice. I can entirely concur in his recommendation, but will not omit to give some short description of the instrument and the method of using it. In the first place, I think that we can do without the apparatus specially designed for this purpose by Wecker, and that the one above described will suffice.

The greatest difficulty in this operation, on the mastering of which its entire success depends, lies, as is well known, in the obliteration of the canaliculi. It seems immaterial to the success of the operation whether the conjunctival or the sacular opening of the canaliculi be closed; but the obliterating the sac is best secured, if, according to Pagenstecher, we close the whole extent of the canaliculi. The platinum galvano-cautery is the best means for accomplishing this purpose, as the wire can be introduced, through the slightly-slit lachrymal points, into the sac, and there be made glowing. Two cases in which I followed this method resulted in complete closure. If there be a fistula of the sac, it suffices to widen it somewhat, so as to be able to introduce a flat platinum wire, and then to bring

* *Traité des Maladies des Yeux.* Paris, 1867. Tome premier, p. 903.

it, while glowing, in contact with the whole wall. At the same time the opening is large enough to give exit to the pus and eschar. If, as is usually the case, the canaliculi are already slit, it will be better to introduce the wire through the fistula, and then by the aid of forceps to conduct it through the canaliculi into the conjunctival sac; we are then more certain to bring the caustic in contact with the inner openings of the canaliculi. I have successfully performed obliteration of the sac by this method four times.

Before deciding upon the operation, and running the risk of substituting continual lachrymation for a periodically recurring inflammation, I avail myself of an observation which did not escape the penetrating eye of *Von Graefe*, the correctness of which I have confirmed in three cases. He states that from the configuration of the face we can with probability say, before the operation, whether, after closing the canaliculi, the secretion of tears will be profuse or not. Hypersecretion of tears is less to be feared in broad, flat faces, with orbits wide apart, and but little prominence of the nose, than in narrow, sharply-cut faces. In the latter group of cases we ought only exceptionally to resort to obliteration of the sac. In order to prove the truth of this assertion, I performed a one-sided obliteration on a subject with a narrow, sharply-cut face, who suffered from dacryocystoblennorrhœa, with profuse secretion and capillary fistulæ. The lachrymation following the obliteration was so great, that the patient expressed himself satisfied with the healing of the fistula on one side, and preferred the trouble of

frequently pressing out the sac, to continually wiping away the tears.

A further application of the use of galvano-cautery consists in—

3. *The Treatment of Trichiasis and Distichiasis.*

Nearly all of the known operative procedures for combating this troublesome and, often in its consequences, disastrous condition, are directed to the curing of entropium, the very absence of which is characteristic of this form of disease.* All these methods are justifiable in complete trichiasis, whereas in partial trichiasis means so severe and uncertain in their results should scarcely be resorted to. If we watch the results of all these methods for a long time (transplantation of the hair-bulbs not even excepted), we must openly confess that relapses are not infrequent. This is mostly—and in the methods of transplantation always—due to the fact that it is impossible, without injury, to isolate and displace all the hair-bulbs which when diseased remove their matrix into the cartilage.

This difficulty is avoided only in Snellen's operation. Unfortunately, however, its results are satisfactory in the upper lid alone, where the firmness of the cartilage admits of a sufficient defect, whereas in the lower lid, in which partial trichiasis mainly occurs, its performance is considerably limited, on the one side by the thinness of the cartilage, and on the other side by the necessity of avoiding the lachrymal apparatus. Such considerations as these have caused all surgeons, from Celsus to

* Stellwag v. Carion : Lehrbuch d. Augenheilkunde. 1867. S. 468.

Herzenstein, to resort to means to prevent the false growth of the lashes by the destruction of their roots, without producing too great a loss of substance of the whole lid. The use of glowing heat for this purpose has been already indicated by Celsus,* and it was therefore quite natural to employ galvano-cautery as had been done by Middeldorpf, and recommended by Stellwag v. Carion.† This method now and then gives very good results, although the total loss of the eyelashes is no little disadvantage. Every practitioner knows what insurmountable obstacles the soft, down-like lashes are in the treatment of trichiasis, and how quickly the patient learns to pull out the stiff, firm lashes in order to get rid of the doctor; but it is these fine, down-like lashes which compel them again and again to fall into our hands. These pseudo-cilia also offer an obstacle to the lately re-introduced method of “*illaquatio*,” if that be more than an idle amusement. Celsus, at least, who begins the description of this method with “*Quidam aiunt*,” does not believe in its success, and concludes his description with the words: “*Gluten quo vinctus est pilus, resolvitur; eoque fit, ut is eo, unde vi abductus est, redeat*.” He asserts, moreover: “*Id fieri non potest, nisi in pilo longiore, cum fere breves, eo, loco, nascantur*,” namely in *exteriori parte palpebræ*.

I have at different times tried this method of operat-

* Celsus: De medicina libri Octo, liber vii. Tenuis acus ferrea in ignem conjicienda est; deinde candens sub ipsis pilorum radicibus ab angulo immittenda est . . . , quo fit, ut omnes pilorum radices ad ustæ emoriantur.

† Lehrbuch der Augenheilkunde. 1867. S. 476.

ing, but have found its performance relatively difficult, and its results nil. For sake of completeness, we mention Gaillard's operation of introducing a suture through the lid, by which doubtless the position of the eyelashes may be corrected, but it leaves such disfiguring scars that for cosmetic reasons its performance is limited. Such observations show that we are still in want of a satisfactory method for the cure of trichiasis, and that it appears justifiable to indicate one, which, at least for partial trichiasis, has always given me satisfactory results. I was led to this procedure by the idea which forms the basis of Snellen's operation, namely, to exercise, through a contraction of the scar in the cartilage itself, a traction upon the tissue covering it.

I sought to attain this result in the following manner: After having protected the lid with a horn-plate, I burn a hole under the roots of the falsely-growing lashes into the cartilage with a very fine galvano-cautery, and allow it to heal by suppuration. The subsequent retraction of the scar is strong enough to remove the lashes from the position which irritated the globe, without destroying them. In this way I have displaced as many as six cilia in one lid, at one sitting, without causing the patient too much pain. The result of this little operation is so excellent that I can safely recommend its imitation. But the cautery must not be applied too near the root of the lash, as the root may be destroyed, or the following scar may not exert a sufficient leverage upon the lash. To accomplish this purpose any other kinds of cautery except galvano-cautery will hardly answer, because they do not penetrate deeply enough; a glowing

needle will cool before it has entered the cartilage, while the galvano-cautery can be kept glowing at will. For partial trichiasis, I know of no method which can compare with that just described in simplicity, painlessness, and certainty of result.

4. *Blepharitis Ciliaris Ulcerosa.*

Now and then there occur cases of blepharitis, with such deep ulcerations of the borders of the lid, that cauterizing with lapis causes the patient intense pain, and gives the physician some trouble on account of the necessity of neutralizing the caustic. I have also, in such cases, preferred to use galvano-cautery, and have observed that healing is more quickly induced in consequence of the cautery penetrating more deeply, while the pain is less severe than in the application of any other form of cautery.

5. I have likewise used galvano-cautery in various *new-formations* in the vicinity of the eye, such as *small cavernous tumors, telangiectasie, naevi vasculosi et pilosi*, where I have always had an opportunity of observing the formation of a nice scar. I once destroyed in this manner a small cancrroid of the inner angle of the eye, in a lady who feared the knife, but I cannot recommend it for imitation, as the eschar prevents us from accurately determining the limits of the new growth. I need not give special rules for the use of galvano-cautery in the destruction of these new-formations, as this is done according to general surgical principles, for the discussion of which these Archives are not the proper place.

Finally, I will report on a method of applying galva-

no-cautery in which, although I have only five cases to bear witness to its efficacy, the healing was so striking and lasting that I do not hesitate to report them; the cases in question have reference to the *cruces ophthalmologorum*, viz. :

6. *Old and Obstinate Cases of Trachoma Conjunctivæ.*

It is well known that KORN, of Breslau, was the first to practise the use of galvano-cautery for the purpose of causing absorption of trachomatous granulations by the formation of a slight eschar. Although he thought very highly of his results, I do not remember that results obtained in a similar way have ever been published. So far as I can understand Korn's deduction, he used galvano-cautery only to enhance the action of the usual caustics, and took pains not to destroy anything more than the conjunctival epithelium, which rapidly regenerates itself.

I think that I have convinced myself, by experiments on the conjunctiva of rabbits, that it is nearly impossible to obtain so slight an effect with galvano-cautery, but that the superficial papillary tissue is almost always destroyed at the same time. If I nevertheless used galvano-cautery in the treatment of trachoma I was, of course, not guided by the opinion of Korn, but by different principles, the final object of which was the partial destruction of the trachomatous new-formation. Unfortunately, in spite of many recent investigations on this subject, the clinical and anatomico-pathological notions of trachoma do not yet harmonize. Even though pathological anatomy has, perhaps, succeeded in separating

the idea of papillary trachoma (Stellwag v. Carion) from the complex of symptoms designated as trachoma, and has proved that the swelling of the papillary body is only a consecutive condition, it has hardly commenced to throw light on the nature of the *specific* degenerations of the tissue of the conjunctiva.*

Is the trachomatous degeneration a local disease of the conjunctiva, or the symptom of an existing general disease (Arlt)? Are the trachoma granules hyperplasies of a normal tissue existing in the conjunctiva (v. Graefe; Blumberg's adenoid tissue) or immigrations of foreign elements? Are the trachoma granulations a homologous or a heterologous new-formation?

A decisive answer to all of these questions, which are still veiled in darkness, can alone give us a point of departure for a rational treatment; for all efforts to solve these questions which have yet been made are so defective that they do more to prejudice a clear judgment than to enlighten it. Nothing is left for the practitioner except to treat the trachoma symptomatically; and here, doubtless, the principal point of the treatment *is the relation of the papillary body to the trachomatous infiltration*. If this relation is a favorable one, that is to say, if the papillary body still exists to such a degree as to be able to absorb the granulations by means of an increased vascularity, then the application of slightly irritating caustics is in place, and, with Celsus, Blum-

* It is just this anatomical darkness which explains that so unscientific a designation as *Τραχώμα* (from *Τραχύνω*, to make rough, roughness) still clings to a disease, the practical significance of which would require a name that indicates certain anatomical conditions, and at the same time gives sure therapeutical indications.

berg,* and many others. I should condemn the opinion "that the object of the treatment of trachoma is to destroy the trachomatous granulations."

But in those cases which Stellwag v. Carion designates as "pure granular trachoma," in which the whole conjunctiva palpebrarum, as far as the reflexion fold, is covered by gelatinous, spawn-like granulations, and the entire conjunctiva appears pale and bloodless, the therapeutic question appears different to me. If we examine such a conjunctiva more minutely we shall find that the granules which project more or less above the level of the conjunctiva are pale and wax-like, while in the valleys, between the elevations, a somewhat varicose vessel (vein?), which bifurcates and embraces the granulation, is usually to be seen. If to such a conjunctiva as this I apply a caustic, which is already dissolved, or which dissolves itself in the conjunctiva by absorption, what will be its effect? It will first cauterize, more or less superficially, those granulations with which it comes in contact, without materially changing their vascularity; as, owing to the absence of vessels, their vegetative life is very weak. If in a favorable case a part of the caustic penetrates to the vessels in the valleys, then their walls will contract under this irritation, and their subsequent relaxation will permit a greater influx of blood.

This method of treatment, however, offers two dangers. On the one hand, a number of the vessels become obliterated by the pressure of the hyperplastic newformation, on account of which the others cannot exert

* Archiv f. Ophthalm., xv. 1869. S. 150.

an increased activity of absorption; on the other hand, we have to fear that the repeated irritation of the caustic, which by lack of strength often fails to destroy the granulations, may give rise to the very process which we intended to conquer—a multiplication of cell-elements and new crops of the morbid products. Every practitioner must have experienced this inconvenience in the treatment of gelatinous trachoma. But here the orthodox objection will be made, “that it is an unpardonable blunder to touch the trachomatous granulations with a caustic; on the contrary, only a part of the conjunctiva, especially that which contains the papillæ, ought to be slightly touched with the caustic, in order to stimulate its activity.” The answer to this objection is given in the above-described form of disease, in which the vascular papillæ are so diminished in quantity, so changed in quality, and so inaccessible, that as a matter of course the application of caustics is inadmissible, as daily experience teaches us that its application is usually followed by the results above described.

If gelatinous trachoma in its advanced stage is left to itself, it may, as is well known, spontaneously end in apparent resolution. This occurs in the following manner: The trachoma granules undergo a retrogressive metamorphosis, become destroyed by shrinkage, and leave a cicatricial mucous membrane and tarsal cartilage—changes which lay the foundation for such complications as xerosis, entropium, etc.

It is obvious that two factors combine to bring about these cicatricial degenerations, *i.e.*, defects produced in the normal tissue of the conjunctiva by the granulations,

and atrophy of the vascular papillæ caused by pressure of the new growth. The object in treatment is to break, while it is still possible, this *circulus vitiosus* (as such the just-mentioned condition must appear even to the most superficial observer). I think that it is possible to meet this indication so long as complete shrinkage has not occurred, so long as a part of the papillary body still exists; and I hold that the only way to accomplish this is by a *gradual destruction of the isolated follicles*. If we succeed, for example, in causing a granule to shrink rapidly, then it is clear that the neighboring papillæ are relieved from a part of the pressure upon them, and the rest of the vascular loops become free. If the liberation of the circulation takes place slowly, through gradual destruction of the granulations, then we can *à priori* expect that the restoration of the papillary body will be brought about without too great vascular activity, and has still time to fill in the defects in the tissue. Certainly the success, that is, the initiation, of this supposed mechanical process, depends upon the fact that a granule only, and not the adjacent conjunctiva, is destroyed. No caustic hitherto employed has answered this purpose. The excision of the granulations, even by the most cautious methods, must include a part of the surrounding conjunctiva, and the stronger caustics, such as lapis in substance, or kali causticum, cannot be used in such a manner as not to affect the conjunctiva by their solution.

I believe that this fact explains the discredit into which the destruction of the granulations has fallen. I have found that galvano-cautery accomplishes remark-

ably well the isolated destruction of the new-formations. I will readily confess that it may seem strange, and that it has cost me a great effort to make for the first time, on this theoretical basis, with a white-hot platinum wire, an application to a deeply diseased conjunctiva. I believe, therefore, that I cannot better illustrate the result of this treatment than by reporting the first case which I have cured by a method presently to be described.

Miss v. B., a tall, slender blonde of 19 years, presented herself to me on the 4th of September, 1870, with granular conjunctivitis of the right eye of ten years' duration. At the time she presented herself the difficulty was not severe, but she told me that the eye was every now and then inflamed, and the vision at the same time obscured. Rather dense opacities of the cornea, to which at this time no blood-vessels ran, indicated the previous attacks of inflammation. The granular process was limited to the conjunctiva palpebrarum, and almost that part alone which covers the cartilage, the reflexion-fold being but slightly affected and showing only a few cicatrices. The tarsal parts of the conjunctiva were closely beset with gelatinous granulations, and were waxy-pale.

As a matter of course, during the ten years' duration of her eye-affection, the patient had been treated with all sorts of remedies, both external and internal, and had just passed five months in an ophthalmic institute. Without being asked, she told me at once that her eye could not bear any caustic; even the mildest applications made it worse.

She wished very much to be freed from these ever-recurring inflammations, but had given up the hope of ever using the eye again. Under these circumstances, I decided upon a cautious destruction of the isolated granulations by galvano-cautery, hoping that the good vascularity of the reflexion-fold would secure the restitution of the blood-vessels. On the first day I very slightly touched the centre of two of the most prominent granulations with a very fine platina wire, which pierced the granulation with a hissing sound, and was withdrawn cold.

The patient, who was very timid, wondered at the complete painlessness of the burning, for she still had a painful recollection of the cauterizations with cuprum and other caustics. This painlessness proved to me that the galvano-cautery had only touched the granulation, and not the conjunctival tissue proper. The reaction after this application, against my expectation, was nil. In the course of a week the two granulations had entirely shrunk, the scars were punctiform and scarcely visible, whereas the adjacent conjunctiva had become decidedly less torpid. After a week, I subjected some other granulations to the galvano-cautery treatment, and I had already become so bold as to cauterize six of them. This time also the reaction was insignificant, and the shrinking, with subsequent vascularization, went on very favorably. Every week I repeated this treatment in the same way with the best success, so that, after the lapse of four months, the patient was cured. The condition of the conjunctiva was as follows : All the granulations had disappeared, the papillary body extensively vascularized, and only here and there a small, soft scar was seen in the conjunctival tissue, whereas the cartilages showed no change in form. This favorable result, up to the hour of my writing, has not been impaired by a relapse, while the cornea in the meanwhile has cleared so far that $S = \frac{1}{2}$.

This result must doubtless be considered a good one, and even the greatest purist in treatment of trachoma by absorption must have his objections modified by the fact that only slight scars of the conjunctiva remained, as according to my experience a severe trachoma never ends without leaving scarry sclerosis of the conjunctiva, whatever treatment may have been resorted to. I can sincerely assert that in the case just reported the scars caused by galvano-cautery were slighter than in many cases treated by sulphate of copper.

In support of this assertion, I refer to Wecker : *

* L. c. Tome i., p. 98.

“Le pronostic sera tout autre si la conjonctive se trouve hérissée de véritable granulations. Il ne nous sera possible alors de rendre à la muqueuse son état normal qu'après un traitement excessivement long, et nous ne pourrons que *très-rarement* remédier à la production d'une foule de cicatrices qui sont la conséquence des véritables granulations.”

As this case, however, might have been only a favorable accident, I did not omit to subject the next analogous case of trachoma to a similar treatment. This occurred on Feb. 14th, 1872.

Mrs. B., of Cologne, who had heard from my patient of her cure, came to me with a chronic gelatinous trachoma of the left eye, which in spite of all treatment she had had for three years. She asked me to burn it away “according to my method.” The case was more favorable than the other, in so far as the disease was of shorter duration, and during all the inflammatory attacks the cornea remained entirely clear. On the other hand, it was less favorable, as the reflexion-folds were also gelatinously infiltrated, and bulged by eversion of the lids. The result of the galvano-cautery treatment was an equally favorable one. The eye became quite cured, leaving very slight linear scars, and no deformity of the cartilage. In this case, however, the treatment lasted until August 23d.

This long duration of the treatment is explained by my applying the cautery at much longer intervals, because after an accidental absence of the patient for four weeks, I observed that the granulations last cauterized (four weeks ago), had become smaller without direct cauterization. I concluded therefore, from this observation, that the vascular loops liberated by the destruction of one granulation might, under particularly favorable circumstances, exercise an absorbing influence upon the

surrounding granulations. For this reason, I now cauterized the granulations in insulated groups, at intervals of from three to four weeks. I have also followed this method of treatment in three other cases; the duration of treatment was from three to five months. As, however, the course of these cases presents nothing of interest, either as regards a further development of the method or of any peculiar accident, I do not wish to lengthen this communication by reporting them. I am quite aware that five cases are too small a material from which to make deductions as to the usefulness of a method. Nevertheless, as this method possesses of all others the great advantage of being less painful in its application, entirely without danger, and in its termination, as regards the formation of scars, is not more objectionable than the others, besides having the advantage of a more speedy cure, and being less troublesome to the patient, I do not hesitate to submit it to the profession for their examination, while I shall not fail to publish my further experience when I have made a greater number of observations.

THE CONNECTIONS BETWEEN THE OSSICLES OF HEARING.

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(With two lithographic plates, Tables III. and IV., and two wood-cuts.)

EVER since the connections between the ossicles of hearing have been microscopically examined according to the latest improved methods, results differing from those previously obtained have been arrived at, and it is obvious, considering the minuteness and delicacy of the parts which come under consideration, that the mere macroscopic examination could not be sufficient. Up to the present time there has been a diversity of opinion on many points of the question before us, though it seems necessary that these fundamental conditions should once be cleared up.

Hitherto the connection between the hammer and the anvil, and that between the anvil and the stirrup, have been considered by all authors as true articulations, whereas the insertion of the stapes into the fenestra ovalis has been recognized to be a symphysis, and the attachment of the short process of the incus to the wall of the tympanum has been stricken from the list of articulations.

My own investigations have satisfied me that there are

no true articulations at all between the ossicles of hearing, but that the ossicles represent a lever, the parts of which are united with one another, as well as with neighboring parts, by symphyses. I demonstrated this fact * three years ago in regard to the connection between the stapes and oval window, as well as between the stapes and incus. Concerning the former, my investigations have been in perfect harmony with those made at the same time by Eysell † and Buck, ‡ whereas Rüdinger § considers it a sort of semi-articulation, because in the interposed fibrous tissue he found lacunæ filled with fluid, which I must, from what I have observed, pronounce artificial.

Even Rüdinger concedes that there is a fibrous or fibro-cartilaginous mass interposed between the articulating cartilaginous ends of the incudo-stapedial and malleo-incudal connections; which, by the way, conspicuously resemble each other. He was even the first one to point out this condition in the malleo-incudal junction, whereas he considers the interposed tissue as a meniscus which is partially adherent to the circumference of the enveloping capsule. He therefore calls these two connections double-articulations. I have, however, found that the union is complete and that these junctions must be considered as symphyses.

My present investigations refer principally to the malleo-incudal junction.

* Beiträge zur Anatomie und Histologie d. Mittl. Ohrs. Leipsig. 1870.

† Archiv f. Ohrenheilkunde. Bd. v., p. 237.

‡ Archives of Ophthalmology and Otology. Vol. 1, No. 2, p. 613.

§ Beiträge z. Histologie des Gehörorgans. München. 1870.

After decalcification (in alcohol, with 5 per cent. muriatic acid), I imbedded the specimens in a solution of gum-arabic. In compliance with the wishes of a colleague, I venture to give a few hints concerning this excellent though somewhat tedious method. I added about 25 drops of glycerine to a quantity of dissolved gum-arabic, of the consistency of syrup, having the volume of 30 grammes of water. When the specimen was imbedded I allowed the solution of gum-arabic to dry, so that the whole mass might be taken out of the cup and placed in ordinary or somewhat dilute alcohol, in which it lay one or several days, according to the size of the specimen, until it could be cut like cheese. When the relations of the parts are very complicated, it is well to mark the specimen before imbedding, that you may know the plane in which the sections are to be made.

Cutting the malleo-incudal junction in a plane which is nearly parallel to the upper margin of the short process and vertical to the long axis of the malleus—that is, about in the horizontal plane of the head—the following relations are shown (see Figs. 1 and 3).

The corresponding surfaces of the hammer and anvil are covered by a layer of cartilage of an average thickness of about 0.015 mm. Between these surfaces, and continuous with them, is fibrous or fibro-cartilaginous interposed tissue of about 0.030 or 0.040 mm. in diameter, which I will call ligamentous or fibro-cartilaginous disk. It is of nearly equal thickness throughout, forming a continuous layer between the two borders of the hyaline cartilage, and has its thickened circumference in immediate connection with the fixing ligament (formerly called joint-capsule). This fixing ligament consists of delicate parallel straight fibrillæ, being in some places very thick and showing a great similarity to the connecting ligament of the incudo-stapedial symphysis.

The fibro-cartilaginous disk (Rüdinger's meniscus) consists of bundles of dense connective tissue, interspersed here and there with cartilage cells, and is not affected by weak solutions of caustic potash, although containing only traces of elastic tissue. The bundles are often plaited together (see Fig. 4), but I have not succeeded in finding any constant arrangement throughout. At the junction of the fibro-cartilaginous disk with the hyaline cartilage most of the fibres run parallel to the surface of the latter, and they often disappear imperceptibly in the hyaline basis-substance, but in some places the fibres run obliquely to the boundary-surface of the hyaline cartilage, and in Fig. 4 a bundle is seen running vertically and bending abruptly near the boundary-line. The periphery of the ligamentous disk, as we have said before, has a rounded, thickened rim protruding more or less between the hyaline cartilage, and showing a somewhat different structure than the other portions of the disk. It is more glistening, contains more cartilage cells, and in horizontal sections the arrangement of the fibres appears more irregular, in some places coiled and in others reticulated. This thickened edge is in connection with the hyaline cartilage as well as with the fine straight fibrillæ of the fixing ligament, whose fine fibrillæ appear in some places to be in immediate connection and in others even interlaced with those of the disk, the line of demarcation being everywhere distinct. Concerning the occurrence of elastic fibres, the same condition is found in the thickened edge as in the disk itself.

The existence of the ligamentous disk can be easily

proved by careful preparation, and I have found it constant in twelve specimens which I have examined.* It was more difficult to ascertain its connection with the cartilage, and at first my judgment on this point vacillated for a long time, until at last I was able to convince myself of the constant occurrence of this connection.

It has been clear to me from the commencement that we have here not to deal with an ordinary joint and meniscus, as the cavity does not gap equally on the two sides of the fibro-cartilaginous disk; yet, on the other hand, it cannot be denied that the boundary between the cartilage and the disk can be often traced as a fine line (see Fig. 4), which is rendered more conspicuous by the different aspect of the two tissues, and accordingly it might be supposed that there is a true separation, and that the tissues have become shifted. To this it must be added that the calls of the hyaline cartilage become scarcer and at the same time more elongated as they approach the disk, so that at last only a thin strip of hyaline substance is left, such as we find on the articular surfaces of bones.† I have been impressed by close and repeated observations that the boundary-line is only the optical expression of the difference between the two forms of tissue. In fact, there

* This had escaped my notice when writing my former paper. As an excuse, I may say I had paid but little attention to the malleo-incudal connection, and as the greater portion of the disk was accidentally lost, it was supposed there was an ordinary joint. Being now better acquainted with the parts, I can accurately trace shreds of the disk adherent to the hyaline cartilage in those of my former specimens which I have preserved.

† We cannot expect, nor do we find, an epithelium here, as it is never seen in other joints, although, if it should be, it would simplify the question.

are places where this optical boundary is not clearly defined, and where it even seems to be interrupted, and in others *the fibres of the disk disappear gradually in the tissue of the hyaline cartilage*. By stretching the sections of the two bones asunder, either after it is in the field, or, better, before placing the specimen under the microscope, I obtained very demonstrative views, one of which—Fig. 3—I have drawn with the camera lucida. In this figure it is seen that the artificial line of separation coincides in some places with the above-mentioned optical boundary-line (*b*, in Fig. 3), but on the whole it runs through the middle of the ligamentous disk; consequently it is easier to tear the disk asunder than to separate it from the cartilage.

I must discard the idea that I had to deal with pathological adhesions, because it would have been an unusual coincidence if in all of the twelve specimens examined by me there had been a similar condition of total adhesion.

In the newly born there is a uniform, uninterrupted cartilaginous mass connecting the incus and malleus, and the future transformation of the middle layer (the ligamentous disk) is only indicated by the intenser imbibition of some of the cartilage cells with carmine, and their elongated shape, furthermore by the beginning and still indistinct striation of the matrix. The cartilage cells are seen uniformly arranged, and a sharp boundary-line of any middle layer cannot be detected.

The thickened edge here also consists of hyaline cartilage in contradistinction to the ligamentous band, which already shows the same fine fibrillæ as in the adult. Although this cannot serve as conclusive evi-

dence, from the fact that in the newly born there are many things in a rudimentary condition, it is, however, of some interest as regards the development of the malleo-incudal articulation.

In conclusion, I may remark that I have never seen a blood-vessel in the disk. The disk, no doubt, is nourished partially from the bone and partially from the periphery. In the newly born, where the middle ear is in a hyperæmic condition and all the vessels are naturally injected, I have seen capillaries running into the thickened edge, but no farther. This want of vessels may give rise to a predisposition to atrophic processes, to sclerosis and calcification of the ligamentous disk.

We shall now examine the *malleo-incudal symphysis* more closely. It can be no longer doubted that the complicated formation of the two surfaces of the bones is of fundamental importance in their mechanical function, and that their peculiar conformation has indeed the striking effect that the two bones become locked when the *membrana tympani* moves inward, while with the opposite movement their connection is loosened. This was first shown by Helmholtz, and is not difficult to demonstrate according to his method.* I could see this locking of the bones very distinctly in a specimen which had lain for some time in Müller's fluid. I ascribe it to the fact that the soft parts (cartilage and capsular ligament) are here better preserved than when subjected to alcohol, by which the delicate parts, on account of rapid drying, become very friable. This seems to

* L. c., p. 29.

prove that the presence of the soft parts is necessary to the above-described action of the bony surfaces. The accuracy with which the two ossicles were locked and unlocked, according to the direction given the handle, was quite remarkable.

Rüdinger* ascribes to his meniscus the function of filling the space between the two incongruous surfaces of the ossicles. But it is easy to convince ourselves, from macerated ossicles, that the complicated surface of the malleus corresponds entirely to that of the incus, and this arrangement is indispensable to the accurate locking of the bones. I cannot understand the use of a movable meniscus; it would rather facilitate the gliding of the two surfaces and embarrass the exactitude with which the slightest motions are transmitted. Although the interposed tissue does not show exactly the same diameter everywhere, nevertheless it does not interfere with the coadaptation of the two surfaces. I avail myself of this opportunity to call attention to the fact that the cogs of the hammer and anvil, when unlocking, do not slide on each other in the "frontal"—transverse—plane only, but in consequence of their screw-like shape separate in the "sagittal"—antero-posterior—plane, as is nicely shown in the model of Helmholtz. The space which is left must, from the limited action of the bones, be very small, and is filled at once by the disk, the above-described thickened edge assisting perhaps to fill the space by the pressure of the tense fixing (capsular) ligament.

It could be supposed that the interposed fibrous tissue would prevent the unlocking of the ossicles. It must be remarked that, according to Helmholtz, the amount of excursion of the malleo-incudal joint does

* He says: If we compare the curvature of the articulating surface of the hammer with that of the anvil, we must necessarily conclude that the interposed elastic tissue as above described is necessary to make the surfaces coincide, not mentioning another important physiological function of this arrangement.—*Monatsschrift für Ohrenh.* 1871, p. 112.

not reach even 5° , because the handle of the hammer, apart from the resistance offered by the symphysis, cannot depart more than $\frac{1}{2}$ mm. from the long process of the incus, and the ligamentous disk will certainly admit of a corresponding degree of extension.

This is proved by the following experiment of Helmholtz.* If after severing the connection between the incus and the stapes we move the handle outward, as far as allowed by the restricting ligaments of the hammer (the ligamentum superius and part of the fibres of the ligamenta externum and anticum, as well as the tensor tympani), the long process of the incus, although following the hammer, departs from the stapes only $\frac{1}{4}$ to $\frac{1}{2}$ mm. If, in this position of the hammer, the long process of the anvil is pressed against the stapes, it remains in its new position, the cogs are unlocked, and there is not sufficient force present to retract the anvil. If the incudo-stapedial joint is preserved, says Helmholtz, the end of the long process of the anvil, of course, is always joined to the stapes; but from the above-described facts it follows that when the handle is driven outward the anvil exerts no traction on the stapes. This is not absolutely correct, as the above-quoted experiment proves that the hammer in its outward movement usually takes the anvil along with it, and a certain degree of traction is necessary to loosen the connection. The cogs are not unlocked until the resistance offered by the incudo-stapedial connection to the outward movement of the long process of the anvil becomes

* *Mechanik d. Gehörknöchelchen Separatabdruck*, p. 36.

greater than its adhesion to the hammer. In order to hear distinctly, it is absolutely necessary that the hammer and anvil be closely connected in their to and fro movements, so that they can vibrate as a whole. If this were not the case, we could not hear tones purely, but jarring sounds would be produced. Such sounds, for instance, are heard, according to Helmholtz, when a tuning-fork of 116 vibrations is held before the ear, and which he explains as follows: "When the excursions of the membrana tympani are very great, the anvil is not driven outward with sufficient force, and cannot, therefore, perfectly follow the excursions of the hammer; the result of this will be that there will be a separation, and during the next inward vibration the anvil receives a shock from the returning hammer."

I consider it to be the particular function of the symphysis to hold the hammer and the anvil close together,* in order to avoid the clashing sounds under ordinary circumstances when the excursions are much less than those just mentioned, leaving, however, sufficient space for extraordinary cases.

Helmholtz was well aware of the close adherence of the hammer and anvil.† He says (p. 41): "It seems

* Helmholtz says (l. c., p. 40), that as long as the ossicles are firmly united the excursions of the handle are less than $\frac{1}{10}$ mm. Buck, in the above-mentioned paper, noticed excursions of the handle amounting to 0.43 mm. in maximum, while one end of an organ-pipe was hermetically connected with the ear of a cadaver by means of a glass tube; but such an intense tone could not be borne by any living ear.

† In his model of the ossicles of hearing, the hammer and the anvil are held together by a spiral spring, which is inserted in the centres of the articular surfaces, and corresponds more nearly to a symphysis than to his own description of the malleo-incudal connection, which he calls (l. c., p. 2) a freely-movable joint enveloped by a delicate, loose, capsular membrane.

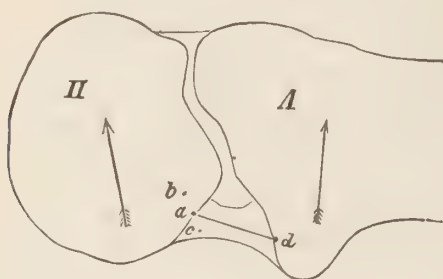
that the articulating surfaces of the hammer and of the anvil adhere to each other by friction, as this can be noticed in the anatomical specimen when the incudostapedial joint has been disconnected, the hammer by suction is drawn outward into the canal."

Of course, the arrangement of the fibres in the ligamentous disk is of importance in reference not only to the kind, but the degree of mobility of the ossicles. I have not yet been able to discover any constant condition, but so much at least is evident, that the fibres do not cross directly by the shortest cut, *i.e.*, they are not vertical to the plane of contact. Their arrangement, on the contrary, seems to indicate a greater motility, which again is modified by the capsular ligament.

This ligament (formerly called capsular membrane) is thickened in two places, and has not yet received due attention. It is most developed in two places; first, in the upper half of the inner side, extending as far as the cog of the anvil. To afford room for this part of the ligament, the bones separate a little, and form a depression, which can be seen by the naked eye, and is also indicated in the majority of illustrations.* Fig. 1., Tab. III., which represents a horizontal section of this region, renders it evident that such a powerful part of the ligament must be of importance, especially when compared with its slight development on the outer side. It is also seen that the fibres run obliquely to the plane of the symphysis, their insertion into the anvil lying nearer to the median line than their insertion into the

* Especially in Gruber's *Studien über das Trommelfell*, Tab. I, Fig. 2, and also in the already-cited paper of Helmholtz, Fig. 9.

hammer. The anvil at this place shows a small projection. The effect of this arrangement is obvious, and easily understood by the assistance of the accompanying figure.



Let $a d$ be a fibre of the ligament which will be stretched when the head of the hammer swings outward, in the direction of the arrow (or when the handle moves inward), because the distance $b d$ is greater than the distance $a d$; but if the head of the hammer goes inward (that is, the handle outward), the distance between the two points is diminished. This ligament is of further significance from the fact that the long process of the anvil somewhat approaches the handle when the handle moves inward.*

The lower part of the symphysis is then locked tight with the cogs, but the upper part would be loosened if the ligament under consideration did not

* This is because the short process of the anvil lies to the inner side of the axis of the hammer, and therefore its end is slightly elevated when the handle is drawn inward, as is easily illustrated by means of a match and two pins; but the short process of the anvil is restricted in its movements by its ligament—the anvil slides along the hammer in such a way that their two long processes approach each other.—*Helmholtz*, l. c., p. 31.

exert a great resistance, aiding, on its part, to increase the pressure.

From what has been said it follows that the ligament serves materially to strengthen the union of the ossicles. The ligament must be most developed in the upper portion of the symphysis, where it is farthest from the axis of rotation, but as it extends to the middle, it secures a still firmer union.

The opposite pole of the symphysis—as I have remarked above—that is, the lower half, or rather the lower third, of its outer side, in the region of the cog of the hammer, is the *second* place where the capsular ligament is strongly developed, as is also stated by Helmholtz.* This part gives the lower portion of the symphysis the firmness necessary for the closer fitting of the cogs, and protects the symphysis from too forcible an extension and consequent rupture. As this ligament is situated near the axis of rotation, it is not affected by the sliding of the hammer on the anvil in the frontal plane, but it is to be remarked that there is a bundle of fibres which arises from the middle of the ligament, and passes to the opposite wall of the tympanum, in a direction vertical to that of the fibres of the ligament. This fibre-bundle, together with the ligament, will be put on the stretch as often as this part of the ossicles is drawn inward. Furthermore, as the

* He says, l. c., p. 29: The periphery of the articulating surfaces is connected by a capsular ligament, which is inserted into grooves encircling the articulation. The capsular ligament is not very strong, and is easily broken even by slight traction upon the bones. Its firmest part are the fibres that spring from the cog of the hammer; from here also several fibres of the *ligamentum externum of the hammer* pass over to the anvil.

corresponding surfaces, in consequence of their screw-like form, not only slide on each other in the frontal plane, but separate to a certain degree when the cogs are loosened, this and the other portions of the capsular (fixing) ligament serve to restrain the separation of the articular surfaces.

Tympano-incudal connection.—Fig. 1 represents a horizontal section of this connection, to which I have again satisfied myself that the end of the processus brevis of the anvil is covered with a thin layer of cartilage, which can be very nicely seen in children, but which is often indistinct in the adult. There are two different portions to be distinguished in the fibrous tissue by which the short process of the anvil is fastened to a corresponding depression in the bone. The portion (*d*) which is fastened to the processus brevis on its outer side differs from the rest (*c*) by its brilliancy, its yellowish color, homogeneous appearance, and indistinct striation, and consists of dense, almost homogeneous connective tissue, which is slightly altered by weak solutions of caustic potassa, and is friable, as it cannot be teased into shreds, but shows only gaps. The remainder of the ligament consists of common fibrous connective tissue, in some horizontal sections of which can be seen a peculiar fascicle (*f*) passing from the top of the processus brevis inward, and consisting of fine straight parallel fibres. The above-mentioned difference is noticeable even in the newly born, where the lateral portion of the ligament, as well as the last-mentioned fascicle, consist of fully-developed connective tissue with fine parallel striation, while the re-

mainder has still the appearance of embryonic connective tissue.

I may mention, in conclusion, that I have never seen the short process of the anvil in immediate contact with the bone in any place, although I have made many successive sections through the incudo-tympanic symphysis, according to the manner described above. I cannot, in the face of my microscopical preparations, agree with Helmholtz when he says (p. 38) "that the hammer, together with the anvil, has to be considered as a one-armed lever whose hypomochlion lies where the apex of the short process of the anvil stems against the wall of the tympanum."

The *Incudo-Stapedial Symphysis*, as well as the peculiar structure of the apex of the long process of the anvil, has been more fully described and illustrated in my former paper, to which I may here refer. For the sake of completeness, and in order to facilitate the comparison with the malleo-incudal symphysis, the drawing, Fig. 5, has been copied, and shows a great similarity between the two symphyses, and also several peculiarities which find their explanation in the different function, and especially in the cog apparatus of the malleo-incudal symphysis. The fixing (capsular) ligament is strongly developed also in the incudo-stapedial symphysis, and consists of similar fine, stiff fibres; here, too, are fibres arising from it which run between the cartilaginous ends of the anvil and stapes and complete a direct connection between the two ossicles by being united to their entire articular surfaces. This bundle of fibres is, however, much more delicate than the ligamentous disk of the

malleo-incudal symphysis, and the thickened edge is also wanting, because the two ossicles are in constant connection, not separating, as in the former, where a more strongly developed bundle of fibres has to fill up the gap. As the end of the anvil (resp.: processus lenticularis) is much smaller than the corresponding part of the stapes, and is at the same time markedly convex, it requires the interposition of a fibro-cartilaginous disk (*a*) thicker at the periphery than at the centre.

Rüdinger terms this likewise a bilocular articulation with a central meniscus; we, therefore, here also differ only in regard to the connection of the intermediate fibre-bundle with the cartilage. After looking over some old preparations made from three adults, I have again satisfied myself that there is no break between the interposed tissue and the cartilaginous surfaces; and considering the delicacy of the parts in question and the difficulty of preserving the connections intact, I believe this to be more conclusive than the opposing evidence. My view seems further strengthened by the striking analogy of the incudo-stapedial with the malleo-incudal connection, which, in my opinion, is beyond doubt a symphysis. Furthermore, I cannot see of what use a meniscus would be in excursions so extremely small, which necessitate the utmost precision, especially when we consider the peculiar form of the articulating surfaces.

I have stated that the tendon of the stapedius may exert an influence upon the tension of the symphysis because its upper fibres are inserted into the connecting ligament, but I cannot agree with Rüdinger's assertion,*

* *Monatsschrift f. Ohrenheilkunde*, 1872, p. 32.

that a portion of the stapedius muscle is inserted into the processus lenticularis of the anvil.

In the newly born this symphysis presents the same appearance as the malleo-incudal symphysis ; here also is a continuous layer of cartilage from the anvil to the stirrup, and the fibrous nature of the interposed tissue can scarcely be traced.

As to the

Symphysis between the base of the Stapes and the Oval Window,

I have nothing new to add. Here also the connection between the cartilaginous rings of the base of the stapes and the oval-window is made up of fine, straight connective-tissue fibres, as shown by the investigations of Eysell, Buck, Rüdinger, and myself. Rüdinger has also found lacunæ in the interposed tissue, and, therefore, calls this connection a semi-articulation. My investigations would lead me to consider these lacunæ as artificial, and I may be allowed to quote the following passage from my former paper (p. 25) : “ In good preparations the interposed connective tissue does not show a central cavity nor any separation of continuity, but the central part (nucleus) seems to differ in certain respects from the peripheral parts ; exhibiting the fine striation less, appearing more homogeneous, with some interspersed cartilage-cells (which, however, are also found here and there in the peripheral parts), and being more deeply stained with carmine. In some preparations this middle part is broken, which seems to indicate that it is more delicate than the other parts.” Neither Eysell nor Buck mention any such cavities as being physiological.

The foregoing description shows that all the connections of the ossicles which are situated in the course of the sound-waves, have a similar arrangement in which the cartilage plays an important part. The same holds good in the

Connection between the Hammer and the Membrana Tympani, in reference to which I will add a few cursory remarks referring to Fig. 6, which is copied from my previous paper. The hammer, as far as in connection with the membrana-tympani, and even a little farther, is covered with a thin layer of cartilage, with which the fibres of the membrana-tympani are uninterruptedly continuous, as in the above-described symphyses.

The cartilage, which is hyaline and particularly well developed on the processus brevis, not only in the small bridge which unites the handle with the drum-head, but surrounds the greater part of the outer surface of the hammer, penetrates the osseous substance, particularly at the lower third, which has to sustain the greatest shock of vibrations. It is to be supposed that by this arrangement the thin handle is rendered more elastic and less fragile. There is no separation between cartilage and bone, as erroneously asserted by Gruber, the contiguous surfaces being ragged and by no means smooth. I think it of importance to state this, because this view of Gruber has been adopted by Helmholtz in his "Mechanism of the Ossicles of the Ear."* On the con-

* Helmholtz says, l. c., p. 17 : In the vicinity of the lower end of the handle the connection of the bone with the thickened tissue of the membrana-tympani is very firm, but in the vicinity of the short process there is a more yielding substance or even a kind of incomplete articular fissure between the bone and the membrana,

trary, the handle of the malleus is united to the membrane throughout its entire length, including the short process, the connecting bridge corresponding on the whole (excepting individual variations) to the middle of the outer surface of the handle, its thickness increasing downwards in proportion to that of the handle. This latter condition alone renders movements of the hammer on the membrana-tympani possible. Near the short process the circumference of the bone is large, but the connecting bridge is narrow, so that a transverse section shows an elongated triangle, with obtuse angles, the base of which looks inward, while its apex rests upon the membrane. On the other hand, the spatula-formed end of the hammer is wholly enveloped by the membrane, its greater diameter lying in the plane of the membrane.

By means of this attachment the upper part of the handle, together with the short process, can be easily rotated on an axis which passes through the middle of the connecting bridge, so far as the spatula-formed end of the hammer and its other attachments admit of such a rotation.

I will not decide the question whether or not the short process slides upon the membrane as a whole. Although the attachment I have just described seems to

which substance is rendered firmer on both edges by the union of the periosteum of the hammer with the edges of the cartilaginous layer and the fibrous tissue of the membrane.

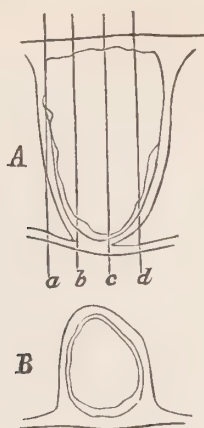
And on p. 32 : At the same time it will be seen that the short process of the hammer must slide on the membrane in these movements, which sliding is possible on account of the peculiar connection between these two parts described by J. Gruber.

render it improbable, yet I would not deny the possibility of very small, especially lateral, movements, which alone come into question, because a little yielding of the connecting bridge seems not impossible.

In my previous paper I have described a slit-shaped cavity appearing in longitudinal sections of the hammer, in reference to which I wish to make a few remarks. It is, as illustrated in Fig. 6, bounded to the outer and inner side by fibres of the *membrana-tympani*, and its inner surface is covered with pavement epithelium.

If longitudinal sections are made through the hammer, vertically to the surface of the membrane, the slit-shaped cavity is seen reaching farther up, but not down in the sections nearer the edges than is shown in Fig. 6. In the sections near the middle the cavity becomes smaller and disappears altogether in two or three sections made directly through the middle in the longitudinal axis where the bridge which connects the handle with the membrane is cut through, but if we continue the sections the cavity reappears.

A glance at the accompanying diagram (*A* representing a section through the upper and *B* through the lower third of the handle) illustrates what has been said. In *A* the longitudinal cuts only, from *b* to *c*, will not show any separation, because they would go through the connecting bridge, whilst a cavity will appear as soon as the section passes through the acute angle formed by the *membrana-tympani* with the lateral surfaces of the hammer.



In the lower third, where the connection between the hammer and the membrane is broader, no such cavity can be seen in a longitudinal section. Now it is evident why the opening is lined with pavement epithelium—the epithelium of the inner surface of the membrana and of the ossicles—and why it is surrounded by fibres from the membrane which, as is well known, encircles the hammer.

This is in harmony with my former investigations, except I supposed the posterior cavity was a lacuna between the fibres surrounding the hammer and those that pass from the membrane to the hammer,* but I have satisfied myself that this lacuna is not constant, and I have also made a drawing of a bridge consisting of a granular substance and situated in the anterior deep furrow (looking towards the tube) between the membrana and the outer surface of the hammer. This bridge I am now inclined to consider as accidental.

* *L. c.*, pp. 18 and 20, Figs. 9, 10, and 13, *c.*

I have nothing new to add on the manner in which the fibres of the membrana pass over to the hammer, and on their course, as I have not given the subject sufficient attention, but I am sure there are many interesting facts still to be found.

In my recent researches my opinion has been confirmed, that the connection between the hammer and the membrana does not exactly coincide with the middle line of the outer surface of the hammer, but with a line lying more towards its posterior edge, while at the anterior edge a more or less deep fissure is found where the hammer only lies against the membrane: * I, of course, speak only in reference to the middle and upper parts of the handle. This is certainly of great importance in the mechanism of the parts, because the hammer is more easily rotated upon its longitudinal axis in one direction than another. I will not decide the question whether this has any relation to the eccentric insertion of the tensor-tympani into the anterior edge of the inner surface of the malleus.

I have again been struck with the looseness with which the middle and upper thirds of the handle are connected with the membrane. I have again obtained transverse sections like those drawn in Figs. 14 and 15 of my previous paper.

APPENDIX CONCERNING PRUSSAK'S SPACE AND THE
POUCHES OF THE MEMBRANA TYMPANI.

In the *Archiv für Ohrenheilkunde*, vol. 3, p. 265, Prussak has described a space between the membrana-

* Compare Figs. 10 and 11, l. c.

flaccida and the neck of the hammer which he calls the *upper pouch of the membrana-tympani*. Its borders are, according to his description, as follows: To the *outer* side, the *membrana flaccida* (see *K*, Fig. 6, Tab. IV.); to the *inner* and *lower* side, the neck of the hammer and the upper surface of the short process; to the *upper* side, a ligamentous membrane which passes from the *margo-tympanicus* to the *spina mallei* (evidently the *ligamentum mallei externum*); to the *anterior* side it is bordered by the anterior duplicature of the *membrana-tympani*, that is, the upper blind end of the anterior pouch; to the *posterior* side it communicates, above the posterior pouch, with the drum-cavity by a moderately large opening.

I have already stated my conviction that this upper pouch of Prussak is identical with the space *K*, Fig. 6, which I have found constant in all longitudinal sections, but formerly I could not trace the lateral connection between this space with the tympanum. I think every one who compares Fig. 6 with Prussak's description will be convinced of this identity. Prussak's drawings, however, are somewhat deficient, and for this reason his statements have been misunderstood by some, for instance by Helmholtz.* For the majority of cases I can confirm the statement of Prussak that this upper pouch has only one orifice, lying behind and above the posterior pouch, between the *processus brevis* and *ligamentum posticum* (*b* in Fig. 8), and admitting of the introduction of a moderate-sized probe. Nevertheless

* L. c., p. 20.

this opening, in one case, was connected with the anterior pouch, so I think there may be individual variations. The anterior pouch usually ends in a cupola-like cul-de-sac and on a level with the short process and the spina tympanica major; and the septum which separates it from Prussak's space can be seen by transmitted light from outside. It is the line which passes from *a*, Fig. 7, to the hammer, and which separates the membrana-tympani proper from the membrana-flaccida.

On account of its narrow entrance Prussak's space is easily filled with mucus, occasionally causing its rupture. To this condition certain appearances in the living may be referred, showing, immediately above the processus brevis, a cupola-like, dull, glistening, somewhat prominent place resembling a small sago grain. But I cannot share Prussak's view, that the vibrations of the upper end of the lever-shaped hammer are interfered with by such an accumulation of mucus, because the movements in question are too small and the walls of the cavity are rigid only in some places.

To illustrate these conditions I have added two drawings (Figs. 7 and 8), representing the inner and outer surfaces of the membrana in connection with the hammer. In order to show the parts inside, the anvil was removed.

In Fig. 7, at *a*, we see the spina-tympanica major (Helmholtz),* and at *a'* the spina-tympanica minor, and between them the Rivinian recess is situated. If light is thrown obliquely on the membrane, the free margin

* Henle (Handbuch der Anatomie, vol. 2, p. 738) calls it the spina tympanica posterior, not referring to the Rivinian recess.

of the posterior pouch is visible at *c*, with the chorda tympani entering at *d* into the projecting bony ledge; besides, a cord is to be seen passing from the spinæ tympanicæ major and minor to the hammer, separating the membrana-tympani proper from the membrana-flaccida, which is situated in the Rivinian recess, contains no fibres from the membrana-tympani but only common connective tissue, and has been called by Helmholtz the upper supporting ligament of the drum-head. The posterior part of this cord arising from *a'* is the longer, and represents at the same time the line of insertion of the posterior pouch into the drum membrane; *b* is the region of Prussak's space, or the upper pouch. I do not think that it extends as far as the whole membrana-flaccida, as stated by Prussak; on the contrary, it occupies only a portion of it, as can be seen by its entrance, represented in Fig. 8.

The Rivinian recess, as is well known, serves two purposes; first, it allows space for the upper part of the hammer and its excursions, and secondly, it furnishes places of attachment for the malleolar ligaments. It surrounds the neck of the hammer, as can be seen in macerated temporal bones, like a narrow semicircular cornice to which are attached the ligamenta mallei anticum, externum, and posticum, the principal supports of the hammer. In many preparations, the spina tympanica major especially encircles the neck of the hammer like a sharp hook with its point looking backwards.

In Fig. 8 the relations of the posterior pouch to the drumhead and the membrana-flaccida are shown, as well as the entrance of the upper pouch. I have taken

particular pains to illustrate the articulating surface (*sit venia verbo*) of the hammer. It will be seen that the line of insertion of the posterior pouch into the drum-head crosses the chorda tympani and reaches the hammer somewhat below the place where the chorda leaves it.

The chorda, always following the free margin of the pouch, causes the arrangement represented in the drawing, viz. : the pouch appears twisted upon its axis (like a towel when wrung), its anterior quarter opening in an upward direction, but not downward like the other three quarters. This arrangement was found at least in the specimen taken for illustration, as well as in several others, but I willingly confess that, as to these minor details, many variations may occur.

At *b* the posterior bundles of the ligamentum externum are seen, which Helmholtz describes as ligamentum posticum, and a little below, a lateral, *i.e.*, posterior view of the short process is obtained, between which and the ligamentum externum, is the entrance to the upper pouch of Prussak. At *a* is the place where I have always found the chorda attached to the long process of the anvil. (This attachment is constant, also, according to Henle.)

While the posterior pouch shows true fibres of the membrana-tympani, which run principally in the direction of its free margin, I could not find them in sections made through the anterior pouch, which deserves its name less than the posterior, and has been over-estimated in its significance. I consider it a mere duplication of the mucous membrane which lines the structures

entering the Glaserian fissure, and is reflected from the neck of the hammer to the spina tympanica major and to the tendon of the tensor-tympani.

The significance of the posterior pouch also is not yet definitely ascertained, and it remains to be determined whether its main function is to support the hammer, or the chorda tympani.

EXPLANATION OF THE FIGURES IN PLATES III. AND IV.

All of the Figures, with the exception of Figs. 7 and 8, have been drawn by the aid of the camera lucida. Figs. 5 and 6 are taken from my paper, "Beiträge zur Anatomie und Histologie des mittleren Ohrs."

TAB. III.

Fig. 1. Horizontal section through the upper half of the malleo-incudal symphysis of the adult. *H*, head of hammer. *A*, body, and *A'*, short process of anvil. *P*, outer wall of the tympanum. *a*, hyaline cartilage; *b*, thickened edge; *c*, capsular ligament on inner side; *c'*, same on outer side; *d*, faintly striated but more homogeneous connective tissue, of a peculiar lustre, from the outer portion of the incudo-tympanal connection; *e*, ordinary connective tissue; *f*, a fascicle with delicate and parallel fibrillæ.

Fig. 2. A deeper section of the under half of the symphysis, being in the same direction, and viewed with the same power, and lettered the same as in Fig. 1. From *c'*, the outer capsular ligament, a fascicle of connective tissue passes to the opposite wall of the tympanum.

Fig. 3. 70 diam. Horizontal section of the upper portion of the malleo-incudal symphysis of the adult, as in Figs. 1 and 2. The connection was intentionally loosened, and the greater part of the line of separation passes through the ligamentous disk. *H*, hammer. *A*, anvil. *a*, bone; *b*, hyaline cartilage; *c*, ligamentous disk (fibro-cartilaginous); *d*, thickened edge; *e*, outer, *e'*, inner capsular ligament.

Fig. 4. 100 diam. From the adult, section as above. Portion of ligamentous disk united to the hyaline cartilage. *a*, bone (malleus);

b, hyaline cartilage; *c*, ligamentous disk. Incudal portion of disk not drawn.

Fig. 5. 90 *diam.* Section, from the adult, through the end of long process of anvil and incudo-stapedial symphysis, horizontal to the long process of the anvil and perpendicular to the membrana-tympani. *A*, long process of anvil. *A'*, Os-Sylvii. *B*, head of stapes. *a*, fibro-cartilaginous disk; *b*, hyaline cartilage, the cartilage-cells being wanting in the immediate vicinity of the ligamentous disk, therefore a small stripe of hyaline matrix, *c*, appears; *d*, stripe of connective tissue passing through the middle of the symphysis (ligamentous disk); *e*, capsular ligaments; *f*, tense connective tissue.

TAB. IV.

Fig. 6. 20 *diam.* Longitudinal section through the hammer, perpendicular to the membrana-tympani, of the adult. *A*, rim of bone at the upper (Rivian) recess of the membrana-tympani. *B*, head of hammer. *C*, neck of hammer. *D*, handle of hammer. *E*, processus brevis mallei. *F*, membrana-flaccida. *G*, ligamentum externum mallei. *H*, chorda-tympani. *I*, tendon of the tensor tympani. *K*, Prussak's upper pouch of the membrana-tympani. *a*, cartilage; *b*, fibres of the membrana-tymp.; *c*, dermoid layer of the membrana-tymp.; *d*, cavity; *e*, haversian canals; *f*, small medullary space.

Fig. 7. Outer view of the membrana-tympani when held obliquely toward the light. *a*, spina tympanica major (Helmholtz); *a'*, spina tympanica minor; *b*, Prussak's upper tympanic pouch; *c*, free edge of the posterior pouch (chorda-tympani); *d*, bony ridge at the entrance of the chorda-tympani.

Fig. 8. Inner view of the membrana-tympani, with the anvil removed. *a*, portion of the free border of the posterior pocket of the membrana-tymp., where the chorda is constantly found fastened to the long process of the anvil; *b*, ligamentum mallei posticum; the processus brevis mallei is visible a little below its anterior border; and between the ligament and the process is found the entrance to the upper pouch. The membrana-flaccida extends to the posterior pouch below the ligamentum posticum; *c*, ligamentum externum et anterius mallei; *d*, cut end of the tendon of the tensor tympani; *e*, cog of the hammer; *f*, facial nerve.

CONTRIBUTIONS TO THE PATHOLOGY AND PATHOLOGICAL ANATOMY OF THE OR- GAN OF HEARING.

BY DR. S. MOOS.

(Translated by Dr. C. C. Terry, New York.)

IN the following paragraphs I shall describe a series of post-mortem examinations of diseased ears. If the careful reader find some data which are of value, not alone to the specialist, but to the general practitioner, I beg to state that the credit is primarily due to those of my colleagues who so liberally furnished me the histories and specimens.

CASE I.

Casual discovery of aural catarrh in a case of fatal accident.

K., a robust peasant, 22 years of age, was run over by a railway train, July 3, 1872, and his body nearly cut in two just below the ribs. Thirty-six hours later the autopsy was made by Prof. Knauff. Besides other lesions not pertaining to the auditory apparatus, there were found numerous ecchymoses in the meninges of the anterior cerebral lobes. No other abnormality on and within the skull.

In the naso-pharyngeal cavity evidences of a considerable catarrh. Only the right petrous bone could be examined soon after death. The upper and lateral portions of the external auditory canal, in the vicinity of the drum-head, and the vessels of the handle were injected. Drum-head

itself infiltrated with serum, showing no reflex, markedly concave. The attempt to blow air through the tuba by means of a catheter was met by a considerable resistance, which only gradually gave way with a bubbling sound, followed by the escape of viscid mucus from the pharyngeal end of the tube. The condition of the drum-head remained unchanged. A bulbous sound of 1 mm. in diameter could not be passed through the tube into the tympanum. In the tube itself much glairy mucus, which exhibited under the microscope mucous corpuscles, granulated cells, and cylindrical epithelium.

Mucous lining of the cartilaginous part of the tube very much reddened, but gradually becoming paler in the bony part of the tube and yellow on the labyrinthine wall of the tympanum. It is much thickened and pervaded by isolated varicose vessels, whereas the inner surface of the drum-head is brightly injected. In the antrum mastoideum the injection was more pronounced than on the wall of the labyrinth, increasing toward the mastoid cells, the mucous lining of which was bright-red. The lower half of the tympanum was occupied by serum.

Malleo-incudal articulation free. Mobility of stapes reduced. After removal of their hypertrophied mucous covering, the incus and malleus appeared dark-red. The fibrous and osseous walls of the porus acusticus internus and sheath and trunks of the facial and acoustic nerves were suffused with blood, and this condition extended as far as the first curve of the facial nerve, and the entrance of the acoustic nerve into the axis of the cochlea.

The microscopical examination of the internal ear discovered nothing more of interest.

In a practical point of view the diminished mobility of the stapes is remarkable. A successful evacuation of the exudation by puncture during life would not have perfectly restored its function. The serous effusion into the tympanum must be considered the consequence of the hyperæmia and the occlusion of the Eustachian tube.

CASE II.

Nephritis parenchymatosa chronica. Hydrops anasarca. Chronic aural catarrh on both sides. Hyperæmia of the right, hypertrophy of the left tympanic mucous membrane.

Franziska Baier, a patient in the medical clinique, became affected with ear and eye disease, after having been treated for morbus Brightii several months in Prof. Friedreich's wards. On the 26th of May she complained of pain and noises in both ears; and on the 3d of June of headache, which wore off the next day. On the 8th of June a drastic cathartic was administered, after which the pains and noises in the ear gradually diminished, until by the 14th of June she considered the ears entirely recovered. June 18, uræmia.

I examined the ears on the 21st of August, 1871, one month before her death. She denied to have had ear-disease previous to the end of May, considered her hearing to be normal, and complained of no subjective symptoms. On the day previous there had been singing in the left ear. Both external auditory canals were clear, only a slight hyperæmia existing superiorly at their inner ends. The right drum-head appeared normal, with the exception of a slight opacity of the mucous surface; but the left showed a marked marginal opacity, was quite concave, almost funnel-shaped; below the handle a small lentil-shaped dark spot (atrophy?). Hearing distance for whispering, 7 feet on the right side, 3 feet on the left; for a small watch, 12" and 3". Conduction through the bones good on the right side, weak on the left. Tuning-fork perceived only on left side.

On the part of the eye Prof. Becker diagnosticated venous hyperæmia of the retina, April 6; at that time the papilla was unaffected. On the 1st of July the contour of the papilla was barely distinguishable, the vessels on the left side were clearly perceptible, especially at the periphery. A little later the process was still more advanced, the papilla was no longer to be made out, and the vessels were veiled. Diffuse opacity of the fundus; hæmorrhages at the extreme periphery. July 25, intense retinitis in both eyes, together with striped opacity in the region of the papilla, isolated white spots and numerous ecchymo-

ses are seen in various stages of regression. There was a fine display of regularly disposed white spots in the region of the macula lutea, especially in the right eye. The secondary neuritis was not very intense, especially not in the right eye.

Death occurred September 19. Autopsy the same day.

Anatomical diagnosis : Granular atrophy of both kidneys ; Cholelithiasis ; Hydrops ascites et Anasarca ; Hydrothorax dexter ; Hypertrophica ventriculi cordis sinistra.

Examination of the petrous bones.

Right petrous bone. Inner end of external auditory canal reddened above. Forcing air into the middle ear caused considerable motion of the posterior half of the drum-head ; the anterior half was less movable. Drum-head opaque and infiltrated with serum ; anterior half abnormally concave ; short process and handle perceptible. Mucous lining of the Eustachian tube pale ; mucous lining of the entire middle ear and antrum mastoideum very much reddened, more so than the lining of the mastoid cells. Microscopical examination of the mucous membrane showed the capillaries crowded with blood-corpuscles. Numerous granular globules, and many cells furnished with processes, were seen upon the mucous membrane. The ossicles were readily movable, but injected, the malleus least. On the floor of the tympanic cavity there was a quantity of serum.

Left petrous bone. External auditory canal same condition as right. Inflation of the tympanum caused no movement of the drum-head, which was lustreless and tendinous in appearance at the periphery. At a little distance below the end of the handle there was a sunken spot as large as a lentil (atrophy or scar?). Mucous lining of the entire middle ear considerably thickened. The microscope showed a proliferation of the connective tissue, which again contained many small cells ; the stellate cells were less numerous than on the right side, and cells in a state of fatty degeneration were entirely absent. The vessels were in the same condition as on the right side. The ossicles, covered by hypertrophied mucous membrane, were

quite movable. E. tube free. Proliferation of connective tissue in Rosenmüller's fossa.

Examination of the ear during life, and again after death, showed that the aural affection was not directly related to the kidney disease; the condition of the eyes, however, depended upon that of the kidneys. In all probability there existed, previous to the occurrence of the renal disease, an old catarrhal disease of the throat and the middle ear, with serous effusion into both tympanic cavities. The process was further advanced in the left ear than in the right; and as the patient had no recollection of any discharge from that ear, the above-described appearance of the left drum-head is more correctly ascribed to atrophy than to cicatrization. The absence of mobility in the left drum-head is easily explained by the hypertrophy of the mucous membrane.

CASE III.

Meningitis cerebro-spinalis. Extension of the inflammation along the dura mater into both tympanic cavities. Integrity of the nervous apparatus.

Michael Busch, æt. 22 years, entered the hospital June 29. Was healthy until fourteen days previous to his admission, when he began to feel ill. He was peevish and fretful, and complained of feeling very tired. Ten days previously he began to complain of pains in the head, loins, and limbs; walking caused pains in the feet. The headache was especially severe in the occipital region, extending thence to the neck and down the back; at the same time there was pain in the eyes, which were red and very lachrymose; inappetency; constipa

tion. The pain of the back radiated to the abdomen. The dejections were not involuntary.

After having lain nine days in bed he had a severe chill, became delirious and violent, struggled with the attendants, bit them, and tried to get out of bed. This state continued until the present. He was sleepless. Vomiting occurred frequently in the first days of the disease. At the same time frequent singultus and grinding the teeth. There were no convulsions of the limbs or the face.

Status præsens. Paralysis of both abducens muscles. The mobility of the tongue was not affected, the swallowing movements were impeded. The muscles of the neck were tense, and felt hard; the attempt to move the head, and even the touching of the cervical muscles, was attended with pain. The loins were especially the seat of pain. Herpes labialis. Temp. 38.2.

Treatment.—Ice-bag to the head. Six leeches to each mastoid region. Cold affusions upon the head, while the body was immersed in warm water. Three powders of calomel and jalap, $\bar{a}\bar{a}$ 5 grains. Lungs and heart normal. Spleen enlarged; hyperæsthesia of legs and arms, especially of the right side. Quinine in solution, gr. xv. ad $\frac{3}{4}$ v. At one o'clock a bath of 28, with cold affusions. The headache diminished somewhat.

* After three o'clock great restlessness, high delirium, loud complaints of lumbar pain, frequent grinding the teeth, much thirst. Urine 1025, containing no albumen. Pupils widely dilated. Temperature, 39.4. Pulse, 90.

Became more delirious towards evening, but a warm bath with cold affusions quieted him for the greater part of the night. Frequent spasms of the extremities were noticed, but no grinding of the teeth. During the night two thin stools were passed, but not in bed.

June 30. Temp. 38.2. Pulse 90. Patient answered at random; he lay quietly; frequent jerking of the arms or legs was noticed; now and then complained of pain in the back. The surface, so very sensitive the day before, had lost its hyperæsthesia. The pupils were still widely dilated.

In the course of the day the sensorium appeared to be less oppressed; the patient answered more pertinently. The spasms of the limbs

were less frequent, and the physical excitement had abated. Stool, not in the bed. Temp. 37.8. Pulse 90.

At	7 o'clock	.....	37.8
"	9	"	 38.0
"	11	"	 37.6
"	1	"	 37.8
"	3	"	 37.8
"	5	"	 38.0
"	7	"	 39.2

In the first part of the night great restlessness, struggling to get out of bed; violent delirium; spasms in the right arm. Brygmus. *For the first time*, spasms of the muscles of the face. Next morning quiet; answered that the pain in head and back had moderated. Pupils reacted normally. One stool.

July 1. T. 39.2; P. 80. At 9 A.M., T. 39.4

" " 38.4; " 84. " 11 " " 38.6

" 1 P.M., " 39.4

Two stools, *stat.* idem, " 3 " " 39.2

less paralysis of " 5 " " 38.4

abducens. " 7 " " 38.2

" 9 " " 37.4

" 11 " " 37.4

" 1 A.M., " 38.4

" 3 " " 39.0

" 5 " " 39.6

" 7 " " 39.6

Three warm baths in course of day.

July 2. T. 39.6; P. 96. No stool. Fair night. Rested better. Passed water in bed. Cough since previous evening with mucopurulent sputa, tinged with blood. Swallowing less embarrassed.

July 2. T. 38.2; P. 96. Faeces in bed. Does not answer when spoken to (deafness). Eyes closed. Sensibility diminished. No jactitation. Swallowing unembarrassed. Expectoration ceased.

July 3. T. 38.8; P. 100. Urine and faeces in bed. In the night he talked and sang in delirium. No spasms.

Temperature during night :	9 P.M.,	38.2
	11 "	38.4
	1 A.M.,	38.4
	3 "	38.2
	5 "	38.2
	7 "	38.0

Ptosis. No response.

	1 P.M.,	38.6
	3 "	39.2

Cheeks dilated by expiration. The hyperæsthesia ceased. Evening: Urine in bed. Pulse very rapid. Stat. id. 39.6, 124. The patient died in a comatose condition at half past two in the morning.

Autopsy by Prof. J. Arnold. Rigor mortis marked. Surface pale. Adipose tissue moderate in quantity. Muscles dark-red and well developed. Cranium thin but compact. Sutures normal. A number of pit-like depressions on the inner surface of cranium.

In the longitudinal sinus dark fluid blood and a fresh clot. The pia mater showed great repletion of the veins, besides a high degree of capillary hyperæmia. At the top of the convexity the pia was more opaque, especially along the course of the large vessels. Here and there the opacity had a granular appearance. In some meshes of the arachnoid, yellowish material. The convolutions of the cerebrum were remarkably smooth. The sinuses at the base of the brain stuffed with dark fluid blood, and the pia mater diffusely opaque. The meshes of the arachnoid over the chiasm and pons dotted with yellowish, purulent masses. In the fossæ Sylvii the pia was on both sides very vascular, and exhibited a high degree of serous imbibition. Arachnoid of medulla oblongata infiltrated with pus. Removal of the pia from the convexity accomplished only with laceration of cortical substance, which was deeply tinged, considerably hyperæmic, and softer than normal. Lateral ventricles dilated, filled with turbid serum, which, especially posteriorly, contained yellow flocculi. The ependyma was diffusely opaque, slightly granular, and the vessels below it were turgid.

The mass of the cerebrum was evidently hyperæmic, much infiltrated with serum, and softened; the cerebellum, pons, and medulla oblongata exhibited similar changes in a less degree.

On opening the spinal canal, the external surface of the dura mater spinalis was found to be hyperæmic throughout its whole extent. In the dura and pia, and the meshes of the arachnoid, purulent infiltration, which was most evident at the upper cervical and lower lumbar parts, but more so posteriorly than anteriorly. At the site of the cauda equina was a collection of pus, which formed a large sac. The substance of the marrow showed no particular change in the upper regions, but in the lumbar parts the gray substance was hyperæmic.

The details of the lesions on the part of the thoracic and abdominal organs are sufficiently indicated in the anatomical diagnosis: Meningitis cerebro-spinalis. Suppurative pleuritis on right side. Hepatization of the right lower pulmonary lobe. Enlargement of the spleen.

Examination of the petrous bones.

The dura mater covering both petrous bones showed the above-mentioned changes, and was not easily separable; its prolongations entering the cavities of the bones were quite hyperæmic.

The sheaths of both auditory nerves hyperæmic as far as the entrance of porous acusticus internus, but in the canals both nerves and sheaths normal. Microscopical examination of the hyperæmic parts of the sheaths showed congestion of the vessels and cellular infiltration. The osseous covering of the middle ear dark-red, especially posteriorly, more on right than left side.

In the right external auditory canal a hard, dark mass of ear-wax lying against the drum-head. At the inner end of the canal there was some redness of the upper wall and a less degree along the handle. The posterior fold of the drum-head well marked; the anterior half of the membrana tympani was quite concave and more transparent than the posterior. No light spot. Peripherically, anteriorly and below, was a considerable opacity of the mucous layer. The so-called membrana flaccida was very small, and showed in its middle portion a round pit-like depression, about 1 mm. in diameter.

Mucous lining of middle ear very vascular, hyperæmic and thickened. The lining membrane of the Eustachian tube normal.

At the bottom of the tympanic cavity some serous fluid. A sound of 1 mm. in diameter passed through the Eustachian tube. Inflation caused bulging of the anterior half of the drum-head, but the posterior remained motionless. Malleo-incudal joint and stapes less movable than normal. The macroscopical as well as the microscopical examination of the vestibule, the semicircular canals, the cochlea and their membranous parts, gave only negative results.

Left petrous bone. External auditory canal free, upper wall of its inner end, as also the neighboring parts of drum-head and the handle hyperæmic. Membrana flaccida larger than on the right side, and without a pit-like depression. Epidermic and cuticular layer of the posterior half thickened, the handle consequently less visible. Some serum at the bottom of the tympanic cavity.

Mucous membrane of middle ear both hyperæmic and thickened, but less so than on the right side. Tube in same condition as right. Inflation caused some movement of both halves of the drum-head. Mobility of the ossicles normal.

Sheaths of both tensor tympani muscles hyperæmic, but the fibrillæ appeared normal under the microscope. Labyrinth normal.

The foregoing case illustrates the rare occurrence of a meningitis extending to the middle ear without implicating the nervous apparatus. The way chosen was by the prolongations of the dura mater which pass to the middle ear. Had the disease lasted longer probably there would have been exudation and proliferation of connective tissue, changes which Klebs* first described

* Klebs on "Epidemic Meningitis," in Virchow's Archiv, vol. 34. In the case of a subordinate officer whose hearing was previously good, and who died in the fourth week with extreme exhaustion and total deafness, "the acustici exhibited nothing abnormal, and the terminal apparatus of the nerves showed no lesion to explain the deafness. But in the tympanic cavity were found relics of a very extensive inflammatory process in the form of numerous thick vascular bands of connective tissue which radiated from the ossicles on all sides to the walls of the cavity."

in the tympanic mucous membrane of fatal cases of cerebro-spinal meningitis.

Notwithstanding the rapid course of the meningitis, the integrity of the nervous apparatus is very remarkable, especially if we consider the early extension of the inflammatory process to the middle ear.

CASE IV.

Chronic suppurative inflammation of the right tympanic cavity. Destruction of the drum-head. Caries, with formation of polypi. Inflammation of the membranous labyrinth. Meningitis. Abscess in the right temporal lobe.

K., of Heidelberg, 3½ years old, was brought to me by his mother, May 5, 1872. During a year and a half he had suffered from a sanguino-purulent discharge from the right ear. Latterly the blood had flowed in greater proportion. On examination, the left ear was found normal, but the right was filled by a polypus extending to the meatus auditorius externus. The boy had a lagophthalmus and was very much emaciated; I therefore advised good nourishment; and for fear of retention of pus, I suggested an operation as soon as practicable. I expressed my suspicion of caries, and gave an unfavorable prognosis.

May 29. The operation was made under chloroform. After the removal of numerous polypi, the drum-head was found to be entirely destroyed. By means of the probe I ascertained the existence of caries at the inner end of the canal.

June 8. I saw the patient for the last time. There was a fair amount of purulent discharge and no disquieting symptom.

Subsequently the family physician, Dr. Wolf, reported that in June the boy sustained a moderate attack of scarlatina, during the convalescence from which brain symptoms suddenly appeared. He died July 29.

Autopsy, July 30 (Prof. J. Arnold). Rigor mortis moderate; skin yellowish-white. Abdominal wall very tympanitic and discolored. But little adipose tissue under the skin. Muscles pale. Cranium of

medium thickness, pretty compact. Dura mater adherent, but no more so than usual in young subjects.

On the convexity the pia mater showed great repletion of the veins and slight diffuse opacity with serous infiltration, but at the chiasm and pons it was infiltrated with pus. In the right temporal lobe was a cavity as big as a small apple, filled with pus. Here the pia and dura were matted together and infiltrated with pus. Right lateral ventricle considerably dilated and filled with thin pus. The ependyma diffusely opaque and also infiltrated with pus. The cavity in the temporal lobe was lined by a thick wall of connective tissue covered and infiltrated with pus. The left lateral ventricle larger than normal and containing thin pus. Ependyma thickened. The mass of the brain was moderately hyperæmic, very moist, and in some places perfectly liquefied. The inner surface of the anterior portion of the dura mater was rather hyperæmic besides being infiltrated with pus, and at several places thickly set with cheesy deposits varying in size from a pin's head to a filbert. The lymphatic glands at the angle of the inferior maxillary bone were hyperplastic and partially cheesy; the subcutaneous cellular tissue behind the right ear contained also cheesy material. The muscular tissue of the heart somewhat pale. The bronchial tubes were filled with a large quantity of muco-purulent substance; the mucous membrane was correspondingly altered. The tissue of the upper lobe of the left lung contained air and was elastic; there were only a few atalectatic points. The lower lobe showed extensive atalectasis, spotted hyperæmia, and serous infiltration. By pressure, pus was caused to flow from the transversely cut bronchi.

Firm adhesions at the postero-superior region of the right lung. The tissue of the upper and middle lobes was altered in the same manner as the left lung. The lower lobe contained but little air, was dark red, and thickly set with foci of peribronchial inflammation. There was one spot of the size of a hazel-nut, which was particularly dense and callous.

Spleen considerably enlarged; capsule clear and translucent; tissue compact; Malpighian bodies larger than normal.

Kidneys normal in size, somewhat hyperæmic, and containing a large number of grayish-white dense nodules of the size of a millet-seed.

Liver pretty large ; capsule transparent, and showing under it a large number of hard nodules of millet-seed size. The cut surface was intensely hyperæmic, its acinous structure indistinct ; the tissue was pretty firm, and contained some white nodules. In the left lobe were two cysts, as big as peas, filled with bright-yellow bile. The portal glands were somewhat enlarged, pretty hard, and grayish. The mesenteric glands were enlarged and studded with white nodules.

In the lower part of the ileum the mucous membrane was quite hyperæmic, swollen, and opaque, and also studded with numerous caseous nodules varying in size from a pin's head to a millet-seed. Same appearances in the large intestine. In the vermiform process several of the nodules were ulcerated.

Anatomical diagnosis : Meningitis. Abscess of right temporal lobe. Broncho-pneumonia. Catarrh of small and large intestine. Miliary tuberculosis in liver and kidneys.

Examination of Right Petrous Bone. At the place where the meninges of the right temporal lobe were matted together (vide supra) on the inner anterior surface of the petrous bone, the dura was studded with white cheesy masses, varying in size from a pin's head to a hazelnut, and concerning whose essential character—whether granulation tissue or tubercle—the microscope furnished no insight. They appeared to consist for the most part of granular cells, with now and then a free nucleus. After the diseased portion of dura mater had been raised, it was proved that at the region of the cheesy nodules it was in a condition of intense hyperæmia, and which extended along its prolongations into the fissura petro-squamosa and into the tympanic cavity. *Along this fissure were scattered seven carious spots* of various size ; the largest, almost of the size of a pea and nearly circular in outline, lay anteriorly opposite the eminentia arcuata, and about three mm. distant from it. In the sinus and sulcus lateralis no lesion.

In the external auditory canal, and filling it entirely, was a polypus having its pedicle on the wall of the labyrinth. The bony septum between the auditory canal and the mastoid cells, and also the septa

of the cells, were carious. A probe could easily be passed from the auditory canal into the cells.

Membrana tympani destroyed. The annulus osseus existed only anteriorly. At the inner end of the auditory canal the bony roof was denuded. In the region formed by the floor of the auditory canal and the adjacent floor of the tympanic cavity, lay a sequestrum, and further inward, in front of the tympanic portion of the polypus, was lodged the displaced but otherwise uninjured incus, in such a position that the polypus, springing from the anterior portion of the labyrinthine wall, grew outwards between the two branches of the incus. Mucous lining of the middle ear hyperæmic and hypertrophied. Stapes ankylosed.

The connective tissue between the bony and the membranous semi-circular canals, the canals themselves, the ampullæ, and the membranous sacs, all exhibited a considerable infiltration, mostly of small cells; so also the lamina spiralis membranacea of the cochlea, but in a less degree than the structures of the vestibule. In order to save the specimen the examination was not continued to the canalis facialis.

It is most likely that the entire disease was of a tubercular nature. Excepting the inflammation of the membranous labyrinth, the examination of the petrous bone developed nothing extraordinary. Considering the presence of caries and a sequestrum, the growth of a polypus after the operation was nothing strange. The fatal result could only have been prevented in this case, if the operation had been performed much earlier.

CASE V.

Caries of Pelvis. Suppurative catarrh of the left middle ear with perforation of the drum-head. Numerous otoliths in the labyrinth.

Karl Gimper, died August 8, 1872. Autopsy, August 9. (Surgical Clinic.)

Anatomical diagnosis: Caries of crest of right ilium and right sacro-iliac symphysis. Pulmonary œdema and hypostasis. Amyloid degeneration of liver, spleen, and kidneys. Anæmia of the brain.

Left petrous bone. Dura mater easily separable from the petrous bone; osseous roof of the middle ear bluish red, very thin, and translucent. External auditory canal nearly filled with thin pus; cutis denuded; drum-head drawn far inward; in its antero-superior quadrant an opening as large as a pin's head, the different layers much thickened and grayish red; the handle invisible. The entire mucous lining of the tympanum was dark red and very much relaxed; malleus and incus covered by hypertrophied mucous membrane; malleo-incudal joint and stapes movable. In the labyrinth the most minute examination found nothing abnormal excepting an immense number of otoliths. There were no microscopical evidences of an inflammation having extended from the middle to the internal ear.

Perhaps this development of otoliths depended upon the suppurative disease of the bones. As is well known, Virchow first called attention to the fact, corroborated by subsequent observers, that in morbid processes of the bones attended with loss of osseous substance, for instance in suppuration of bone, osteomalacia, cancer, the so-called chalky metastasis may occur in parenchymatous organs, such as the kidneys, lungs, etc. Perhaps in the present case the otoliths were in this manner related to the caries of the pelvic bones. A larger experience may contribute to the solution of this question.

CASE VI.

Old pleuritis on left side. Chronic tuberculosis of the lungs. Suppurative inflammation of right tympanic cavity: perforation and bulging of the drum-head; development of granulation-tissue in the tympanum. Collection of pus in the upper wall of the external auditory canal. Caries of malleus, incus, and mastoid cells. Integrity of the labyrinth.

C. S., æt. 49, suffered from pleuritis of the left side in the fall of 1868, gradually recovering with collapse of the chest-wall on that side. In the spring of 1869 tuberculosis commenced in both lungs, and terminated fatally June 20, 1870.

March 25, 1870, he came to me for the first time on account of an affection of the right ear.

History of the case. For five weeks, night and day, fearful pains in right ear, behind the ear, and in the occiput; complete deafness, with loud continual buzzing and knocking. Fever, sleeplessness, loss of appetite, and constipation.

Examination. Hearing distance almost nil; loud voice heard only when shouted into the ear.

But the watch and tuning-fork are heard distinctly by conduction through the bones on the affected side. (This remained to the end of life.) A little pus in the external auditory canal. Cutis slightly reddened. Line of demarcation between inner end of auditory canal and drum-head indistinct; drum-head red and thick; malleus invisible. Posterior half, especially the upper quadrant, bulging considerably. Directly below, in the region of the so-called sinus meatus auditorii externi, a granulation. On inflating the tympanum there was no hissing heard, the granulation did not move, nor were the subjective symptoms mitigated. Still, I thought there was in the lower part of the membrane a perforation occluded by the granulation. At all events, I made a large incision in the superior-posterior quadrant of the drum-head, and much blood and pus issued from the wound. There was no consider-

able mitigation of his sufferings either shortly after the operation or in the course of the night. On the following day the wound was found closed, while the middle ear remained impermeable by inflation. No pus appeared in the external auditory canal. I then removed the granulation. There was found a considerable perforation, which had been concealed by the granulation. Pus followed more freely, but the pains continued as much as before. The inability to sleep was considerably relieved during the last two days of the month by means of chloral, but during the first three days of the following month this means became unreliable.

In spite of the purulent discharge through the perforation, there appeared on the fourth day of April a considerable bulging of the superior-posterior quadrant, which was again incised. Much pus came from the wound; the patient was relieved during four hours.

The night following this incision was more comfortable; the patient stated that the discharge became more profuse at periods of three hours. On the following day I found but little pus in the canal. The incision was again healed excepting for a short distance. The bulging reappeared, and the air-douche drove out but very little pus. Incision. In the evening chloral. The night was comfortable. Towards morning, April 6, the same severe pains returned. Objective appearances the same as before the incision of the previous day. Incision. Pains from nine to eleven P.M., then rest till morning, when the pains again increased.

April 7. Same condition as before the previous incision. Incision repeated. Same course as before. Incision was repeated April 9th. After this incision the pain continued two hours, and followed by a comfortable night with no pain. The incision remained open, but now appeared a *new condition*. *On the upper wall of the external canal, at its inner end, was a pretty large swelling, whose long diameter lay in the direction of the long diameter of the canal. The pressure of the speculum caused some pain, but the tumor yielded easily.*

Now air easily passed through the perforation and brought with it a considerable quantity of pus. The permeability of the Eustachian tube was so far restored, that the patient made Valsalva's experiment successfully. But hearing was not improved. April 10th, but little

pain; Valsalva again. Profuse discharge. The same bulging of the upper wall of the external canal; contact with the speculum not painful. The patient stated that the spontaneous pain proceeded principally from the point touched by the speculum. When the canal was carefully cleansed and pressure made from the tragus inward, pus was observed this side the perforated drum-head, but it was impossible to find an opening in the tumor.

It seemed probable that the tumor was caused by an accumulation of pus and communicated with the middle ear. As the subjective symptoms were quite moderate, I delayed incising the tumor, but advised the patient to frequently press the tragus inward. Although I saw him daily until the 20th of April, and the discharge of pus by pressure on the tragus continued, I never was able to find the opening.

April 20th. I made a deep incision into the abscess; there was a free discharge of pus with collapse of the tumor. Although I had the patient under observation for more than a year until his death, I could never discover any symptom of caries or carious fistula in the external auditory canal. The disease appeared rather as a chronic, painless, suppurative, incurable aural catarrh, such as we so frequently see in tuberculous patients.

After the incisions of the wall of the canal and the drum-head had healed, the latter remained drawn inward toward the wall of the labyrinth, and exhibited at its centre a kidney-shaped perforation. The remnant of the drum-head, as also that part of the tympanic lining visible through the perforations, was grayish red and thickened. Nothing could be seen of the malleus, and the discharge was profuse. Until his death, June 20th, 1871, he did not again complain of ear-ache. A fortnight before his death, I noted for the last time conduction through the bones for the watch and tuning-fork, and his ability to hear the voice shouted into his ear. His mental faculties remained intact to the last, and there were no cerebral symptoms.

Autopsy, June 21 (Prof. J. Arnold). Brain bloodless, infiltrated with serum, otherwise normal. Sinuses free; no evidences of caries; the osseous roof of the tympanum and of the mastoid cells was considerably rarefied. The left lung was perfectly compressed and airless, and bound to the wall of the thorax by the thickened pleura. In the

upper lobes there were cavities, as also throughout the right lung, excepting the lower half of the lower lobe. We omit the other data, as unessential as regards the condition of the ear.

Examination of the right petrous bone. Much fluid pus in the external auditory canal. Membranous wall everywhere uniformly thickened and merging into the external surface of the drum-head, which exhibits in its centre a large kidney-shaped perforation, while the rest of the membrane is grayish red and thickened. The malleus invisible. Through the perforation could be seen a portion of the labyrinth wall, which was grayish red, and at some points covered with pus.

Mucous lining of the middle ear, from the bony portion of the Eustachian tube into the mastoid cells, much thickened; considerable quantity of pus in the cells; the central part of the bony cells formed a large sequestrum lying free in the midst of the pus; the antrum mastoideum was also filled with pus. Of the incus there was left only the short process bound to the posterior tympanic wall by connective tissue, and appearing to project by its upper carious end almost across the tympanum. Of the malleus there was found only the carious head lying loosely against the upper tympanic wall, where during life it had been fixed by the hypertrophied mucous membrane. The tendons of the muscles of the middle ear were absent. The anterior half of the foot of the stapes was less movable than normal. In the cochlea and the semicircular canals neither macroscopic nor microscopic changes.

For those who in their practice are blessed with similar cases, the present offers many points of interest, both clinical and practical. I shall try to give a résumé of the case.

The disease commenced as an acute suppurative inflammation of the entire mucous tract of the middle ear, with early hypertrophy of the connective tissue, which soon caused an obstinate impermeability of the tube and a plugging of the opening in the drum-head. The consequence of this condition was a hernial bulging

of the drum-head, which necessitated six consecutive incisions, notwithstanding the perforation. Still the discharge was insufficient, and the pus forced its way from the middle ear into the tissue lining the external canal.*

The sequestrum found in the cavity of the mastoid cells was probably formed at this early stage of the affection; for it is not to be supposed that retention of pus was the only cause of the dreadful pain which continued so many weeks. The subsequent absence of pain—remarkable enough, considering the discovery of a loose sequestrum in the cavity of the mastoid—would be indeed wonderful had the sequestrum been formed at a later period. There was neither redness, swelling, nor pain in the mastoid region. Reasoning from these data, we might assume an acute osteoporotic detachment of the mastoid cells. Considering the complication of lesions in the early period of the disease, and the persistent insufficiency of purulent discharge—the patient coming under observation for the first time after five weeks had passed—it is quite incomprehensible that the brain and its envelopes were not involved.

The necroscopic conditions made it evident that in our case there had been an indication for trephining the

* In my examination of the petrous bone I eagerly sought for traces of the abscess in the wall of the meatus, but all to no purpose. The cuticular layer was everywhere in normal connection with the bone, and the bone-cells of the upper part of the osseous meatus which communicate with the tympanum were not unusually large. There was only the choice between spontaneous abscess and purulent accumulations by gravitation. Having in view the appearances described, I determined upon the latter opinion, despite the absence of signs in the above-mentioned bone-cells.

mastoid process, and yet during life there was nothing to justify it.*

The functional disturbances observed during life, and the hearing of the conduction through the bones when tried by the watch and vibrating tuning-fork, correspond with the necroscopic data, and are sufficiently explained by the lesions of the apparatus of conduction.

CASE VII.

Autopsy of a deaf-mute. Periostitis of the temporal bone. Exostosis in the right tympanic cavity. Ankylosis of all the ossicles on both sides. Bony occlusion of both fenestræ rotundæ. Bony coarctation of the opening between vestibule and cochlea. General diminution of cavities in bony labyrinth. Chalky concretions in both internal auditory canals, and in the membranous sacs of both vestibules. No changes of nervous apparatus.

For the privilege of examining this case I am indebted to my colleague, Dr. Oscar Wolf, of Frankfort.

The parts examined were taken from a deaf-mute of 64 years of age, an inmate of the Frankfort Asylum.

Twelve hours after death the examination revealed the following conditions :

“ Pericardium attached to the thoracic wall by fresh fibrinous adhesions ; in its cavity about five tablespoonfuls of serous fluid.

“ Heart almost doubled in size. Left ventricle very much hypertro-

* In my collection are the two petrous bones from a case of tuberculosis which I studied during life ; they are carious in different places, and contain a central sequestrum in each mastoid process. During life there was intense pain on both sides, but the symptoms of inflammation of the mastoid cells, *i.e.*, redness, swelling, pain under pressure, etc., on the surface, existed only on one side.

phied and dilated ; right ventricle moderately dilated. Insufficiency of mitral and tricuspid valves with short, wrinkled, and nodular margins (apparently results of inflammatory thickening of the subendocardial connective tissue). Envelope of liver opaque and thickened ; liver shrunk at the anterior margin ; thickening and opacity of envelopes of the spleen and kidneys ; the latter were remarkably small and anæmic.

“Hepaticization of lower portions of lungs, upper portions œdematous, and partly emphysematous.

“Brain-substance very dense and somewhat hyperæmic ; Pacchionian bodies moderately developed. The auditory nerves appeared to me to be rather slender. Lateral ventricles moderately dilated, and containing about two teaspoonfuls of serous fluid. No other abnormality.”

The petrous bones removed for examination exhibited at their margins a certain degree of sclerosis at the expense of the lamina vitrea, but without any considerable increase in thickness.

Right petrous bone. External auditory canal of medium calibre, and presenting no abnormality. The drum-head was drawn inward to a funnel-shape ; its anterior half was transparent, its posterior opaque, excepting a little spot behind the middle of the handle ; the vessels of the handle were hyperæmic. On the lower part of the drum-head appeared a curvilinear opacity, extending from the posterior across to the anterior margin, and with the summit of its arch at the umbo.

From the bony portion of the Eustachian tube to the vicinity of the antrum mastoideum the mucous lining of the middle ear was everywhere considerably thickened, and exhibited—as on the left side also—a great number of the pedunculate structures described by Politzer and Kessel, and considered by them physiological. Cartilaginous portion of tube normal. A sound of one mm. in diameter passed easily as far as the bony part of the tube (also on the left side), and gentle force carried it through the bony part also without injury to the mucous lining. The tensor tympani was well developed on both sides ; its microscopic texture was entirely normal. Malleo-incudal articulation rigid, as also the tympanic connections of the incus ; the stapes quite immovable.

The mucous surface of the drum-head, especially its posterior half,

was opaque, and the umbo was hardly one mm. distant from the promontory. From the floor of the tympanum, and covered by its mucous lining, projected a smooth, white, convex exostosis, which was so nearly in contact with the inferior portion of the drum-head that, viewed through the drum-head, it presented the appearance of a chalky concretion in that membrane. The tendon of the tensor tympani was somewhat shortened. The promontory, less convex than normal, appeared to be somewhat stunted. The cavities of the vestibule and cochlea were very small, the fenestra-rotunda occluded by bone, and the communication between vestibule and cochlea so diminished that a bristle could hardly pass.

Left petrous bone. Same condition of auditory canal as on the other side. The drum-head was drawn inward to a funnel shape; it was normally transparent; the vessels of the handle hyperæmic. The tendon of the tensor was much shortened, and the handle, especially its lower part, drawn considerably inward. Same conditions of malleo-incudal joint, incudo-tympanic connections, stapes, and tympanic mucous lining as on the right side. Condition of the communication between vestibule and cochlea similar to that of the other side, and the fenestra-rotunda occluded by bone.

Microscopical examination of the nerve and membranous labyrinth on either side furnished the following data:—

On the inner surface of the periosteum, at the inner end of the porous acousticus internus, as also on the nerve-sheath, there were great numbers of those singular concretions of phosphate of lime described and figured by Arthur Boettcher in *Virchow's Archiv*, Bd. XII., S. 104, *et seqq.* The same kind of bodies were found in the membranous sacs in both vestibules. In regard to those found in the auditory canal, I can add nothing to Boettcher's description. Those lying upon the nerve-sheath were, with few exceptions, isolated; a few were round, some were lemon-shaped, but the predominant form was clubbed. They all showed a concentric arrangement of structure, and on many of them could be demonstrated a concentrically arranged organic envelope. Those on the membranous sacs varied remarkably in size; some were pale and glistening, a few light yellow, nearly all appearing ho-

mogeneous; they were mostly round; only a few were oval or elongated, or oblong, with pointed ends and dumb-bell shaped. They were mostly isolated, here and there aggregated, and at one point forming a large heap. Their concentric layers were less evident than in the case of those found in the internal auditory canal.*

The above-described morbid conditions of the petrous bone were doubtless consequences of an early periostitis of the temporal bone, but whether congenital or appearing and developing in infancy we must leave under discussion. At all events, the hypothesis of periostitis explains in the most natural manner the pathological data, viz., the tympanic exostosis on the right side, the ankylosis of the chain of ossicles, the bony occlusion of both fenestræ rotundæ, the diminution of the vestibulo-cochlear space, and the bony coarctation of their intercommunication.

Whether the chalky concretions found on the vestibular sacs resulted from periostitis, or from senile changes, or from mere accident, I must leave equally undecided. As far as I know, their occurrence at this place has not been noticed hitherto.

Notwithstanding the normal appearances of the ner-

* "Boettcher finds an explanation of the stratification of some of these bodies and the homogeneity of others in the circumstance that when the nucleus remains embedded in the dense tissue of the periosteum it is in the best condition to receive concentric additions from the connective tissue, but when, on the contrary, it is deposited at the internal surface of the periosteum, it develops rather towards the lumen of the auditory canal, which is not completely filled by the nervus acusticus. There the loose texture of the connective substance is less disposed to form concentric layers. The organic matrix becomes impregnated and finally covered with an incrustation, which conceals the inner stratified layers and gives to the whole a homogeneous appearance." Does not the peculiar position of the membranous sacs of the vestibule in the midst of the labyrinthine fluid explain why there is less tendency to concentric stratification of the concretions on the sacs?

vous apparatus, the perfection of the auditory function was impossible in presence of the above-described and very early changes in the sound-conducting apparatus.

The entire absence of any reliable history—not a matter of surprise in the present case—leaves us with no trace of a clue to the etiological points of this early perioritis. At any rate, this case adds another argument to the proposition that we are sometimes justified in seeking the anatomical substrata of congenital deaf-mutism in the peripheric mechanical part of the auditory apparatus.

It is of peculiar physiological interest that the *tensores tympani* showed no microscopic change. Although during the 64 years of this deaf-mute's life they had performed no function as regards audition, still there was no fatty degeneration. The explanation of this is furnished in the observation first made by Ludwig Mayer,* and afterwards confirmed by Kessel and others, that there is an anatomical continuity between the *tensor veli palatini* and the *tensor tympani*. The continual participation of the *tensor tympani* in the act of swallowing had prevented the fatty metamorphosis.

CASE VIII.

Secondary syphilis. Total deafness on right side. Myringitis. Anchylosis of the ossicles. Adhesive inflammation in the labyrinth, with deposition of chalky concretions on the membranous semicircular canals and the sacs.

Gertrude Eppler, a seamstress of Heidelberg, 49 years old, entered the Academic Hospital (Friedreich's Clinique) October 16, 1871.

* Studies on the Anatomy of the *Canalis Eustachii*, by Dr. Ludwig Mayer. Munich, 1866.

She had had two normal deliveries, and had been out of health for six or seven years. In her 17th year she had suddenly become deaf and lost the sight of the right eye after washing her head while in a state of perspiration. Whether there was paralysis at this time could not be ascertained.

During the past six years she had been complaining of pain at the top of the head and parietal regions, and of vertigo. Five days before admission she had fallen in the street, and could still neither stand nor go about unassisted. Previous to this attack she was not paralyzed. Urine passed voluntarily; no stool for eight days. Had never been delirious (according to her son's account). Menses ceased.

Stat. præsens. She lies apathetic, comatose, with ptosis of the right lid; left pupil contracted and reacting very slowly. Head not hot; extremities cool. With the right hand she can press a little, but the left lies motionless. Both legs move at will, but pricking causes no reaction except on left foot. The teeth are clenched, but separable by means of a spatula. Masseters contracted; neither jerking nor spasms. Thoracic organs free. Heart's sounds normal. No atheroma of arteries. Spleen and liver not enlarged. Abdominal walls soft. Aortic pulse perceptible through the walls. No tumors. Vaginal portion of uterus hard, impermeable, not painful under pressure, and not swollen. Prescribed ice-bag, aq. laxat. viennens.; pulse 96.

Oct. 16. Evening, 38.8, 100. No passage. Breathing stertorous. Head hot. Urine passed in bed. Irido-keratitis on both sides.

Oct. 17. 36.2, 104. Two copious thin passages in bed. Wrinkles of left half of face disappeared. Left leg and left hand more sensitive than right. Reflex action everywhere equally good.

She lies apathetic, with closed eyes and small, weak pulse; urinates in bed, and swallows with difficulty.

Oct. 17. 37.2, 120. Very restless from noon till four o'clock, then apathetic again. Sensibility of left half of face diminishing, and left upper lid never opened again. Four passages in bed. Right radial pulse so imperceptible that it cannot be counted; left radial pulse better. Heart-throb still pretty strong, but the coma continues.

Oct. 18. 36.1 under left arm, 35.3 in the right axilla. No passage. Right arm cool to the shoulder, and its pulse imperceptible. Right

foot colder than left. Sensibility of right arm preserved, but lost in left foot. Same reflex action still. Considerable anæsthesia of left arm and foot. Resp. 20 per minute. No ronchi.

Eyes remained closed. It is ascertained that she was formerly treated for venereal disease. Deglutition impossible.

4.30 P. M. Continued deep somnolence.

Radial and cardiac pulse imperceptible. Extremities cool. From time to time a spasmodic inspiration, and death at 4.45 P.M.

Clinical diagnosis: Encephalopathy in consequence of syphilis.

More definite information from the deceased's friends revealed that for many years she had been quite deaf in the right ear.

The post-mortem examination was made Oct. 19.

Anatomical diagnosis: Atrophy of parts of right parietal bone in consequence of gummy tumors. Gelatinous œdema of pia mater. Hydrocephalus internus. Convolutions, especially on left side, flattened and anæmic; in the right corpus striatum a fresh diffuse hæmorrhage. Old syphilitic scars in the liver, especially at the periphery of the right lobe, and a smooth, stellate, cutaneous scar on the flexor side of the right arm. No other noteworthy lesion.

Right petrous bone. A moderate amount of fluid pus in the external canal; cuticle slightly swollen. No distinct line of demarcation at the inner end of the auditory canal and the drum-head. The latter grayish red, flattened; its superficial layers so thickened that the handle is quite imperceptible and the short process only faintly indicated.

Mucous membrane of middle ear pale, but thickened, and the malleo-incudal joint nearly solid. Stapes firmly grown to the fenestra rotunda. The membranous structures of the vestibule are so intimately attached to the periosteum by connective-tissue bands, that in some places it was very difficult to excise a small piece for microscopical purposes; this was particularly the case in the descending portion of the superior semicircular canals. The posterior membranous semicircular canal was only thickened, and not soldered to the periosteum.

The osseous portion of the petrous bone surrounding the posterior semicircular canal was remarkably dark, cut easily, and presented in its sections under the microscope the appearances so fully described by Rindfleisch in the second edition of "Pathological Histology," pages 519 and 520, as rarefactive otitis.

Condition of the labyrinth. The microscopical examination of the semicircular canals and the membranous sacs shows them to be in different stages of inflammation. In those parts of the semicircular canals which could still be isolated (*vide supra*) the epithelium and connective-tissue membrane are no longer distinguishable; they were covered partly by innumerable large and small cells lying close together, partly by a coarse net-work of large capillaries. At certain points of the periphery the connective-tissue membrane was thickened by new-formed connective tissue. Strong bands of connective tissue, infiltrated with cells, project from the periosteum.

The greater part of the vestibular structure appeared to the naked eye yellowish white and thickened, and its original form and structure evidently much disordered. This appearance was due to the presence of a thick layer of connective tissue which covered the membranes everywhere. In some central points of the membrane, where the tissue was less opaque and more reticulate, the connective tissue was found to be infiltrated with cells.

Where the newly-formed connective tissue is most abundant there were seen numerous isolated, and in some places aggregated globular, chalky concretions. These were first described by Arthur Boettcher (*Virchow's Archiv*, Bd. XII.), as found in the internal auditory canal. We have minutely described these concretions in the preceding case.

The lamina spiralis membranacea was evidently changed; it had a lemon color, was much thickened, and appeared under the microscope very opaque, very vascular, and infiltrated with numerous small cells. Of its several zones only the dentate region could be made out.

The above-described anatomical lesions of the organ of hearing furnish a sufficient explanation of the total deafness during life. Leaving out of account the myringitis which supervened toward the end of life, deaf-

ness was due to the anchylosis of the ossicles and the chronic inflammation of the labyrinth. Very probably this condition resulted from secondary syphilis, although the necroscopic data would not of themselves point to it as a specific cause. As far as I know we have not as yet any reliable anatomical signs of syphilitic inflammation of the labyrinth. We know too little of the pathological anatomy of the labyrinth, and especially of its syphilitic lesions, to be able to decide this question.

Voltolini (Virchow's Archiv, Bd. XVII., Section 8) observed hyperæmia in the vestibule, in the beginning of the cochlea, and in the horizontal semicircular canal in a case of tympanic catarrh and probable periostitis in a syphilitic person. Gruber (Lehrbuch der Ohrenkrankheiten, S. 617) found in a syphilitic soldier who died of exanthematic typhus considerable hyperæmia of the tympanic mucous membrane and membranous labyrinth, which appeared to be a good deal thickened. The labyrinthine liquid was sanguinolent and abundant. But in this case it may be asked whether the lesions in the labyrinth should not be ascribed to the typhus. In the present case the labyrinthine lesions were of themselves quite sufficient to cause total deafness even if there had been no anchylosis of the ossicles, and I consider the labyrinthine lesions so serious that the most direct and energetic treatment could not have restored the lost function. Perhaps the chalky concretions in the membranous structures of the vestibule were consequences of the periostitis.

CASE IX.

An exquisite case of cholesteatoma of the right petrous bone. Erysipelas of the face. Leptomeningitis-purulenta basilaris. Abscess of the right temporal and cerebellar lobe. Suppurative inflammation of the ependyma of the lateral ventricle.

Friedrich Reger, aged 20, a weaver, was admitted into the surgical clinique of Dr. Simon, July 7th, 1871.

In former years he suffered frequently from glandular swellings in the neck. He was otherwise healthy and strong. According to his account there has been a discharge from the right ear during the last three months, with entire loss of hearing on that side. About four weeks ago the region in front of and above the right ear became red, swollen, and painful spontaneously and to pressure. The patient came to the clinique to obtain relief from his pain.

In front of and above the ear is a red swelling, which gives fluctuation over the zygomatic process and squamous portion of the temporal bone. There is a profuse purulent discharge from the right ear.

In the cartilaginous portion of the canal is an opening through which the probe reaches denuded bone. The right half of the face is paralyzed, and has been so for a week.

Diagnosis : Otitis of the temporal bone. An incision $1\frac{1}{2}$ inch in length, about 6''' from the tragus and the helix, was made directly into the fluctuating part, the patient being under chloroform. The temporal artery was injured and ligated. There was an abundant flow of pus mixed with inspissated fatty lumps. The probe struck denuded bone at the place which it had reached through the auditory canal. Two little scales of bone as thin as paper were found in the pus. A thread was passed through the ear into the cavity of the abscess, and thence out through the wound. The latter was partially closed by sutures above and below.

July 8. High temperature* in the evening.

* I pass by the record of temperature of this case.

The region of the wound was painful and slightly reddened.

July 9. Erysipelas extending to the right half of the nose and angle of the mouth. Nausea. Inappetency.

July 10. The erysipelas has reached the other side of the face. High fever, with headache.

July 12. The erysipelas has reached the neck. Fever and headache somewhat diminished. Quinine, 10 grains.

July 14. The erysipelas had disappeared from the face, but returns to it from the neck. Very high temperature. Quinine, 10 grains.

July 15. Stat. id. Patient is soporose. Ice-bag.

July 17. The face is swollen to a shapeless mass. Severe headache. The patient answers when spoken to in a loud voice. Quinine. Malaga. Ice-bag to the head.

July 20. Some improvement, but he is still very weak and not quite himself.

July 25. Stat. id. The wound looks well.

July 30. Stat. id.

Aug. 1. Temperature again increased. Frequent vomiting in the night, not from indigestion. Pulse, very hard, 64. Complains of severe pain in the frontal region, and is rather out of his head. At noon convulsions lasting about three minutes. Great restlessness. Perfect unconsciousness.

Aug. 3. Stat. id. Sometimes he is for a little while conscious, but usually appears apathetic. Complains of headache. No difference in the pupils. The wound still looks well.

Aug. 5. He takes no nourishment. Is unconscious, throws himself about in the bed, passes fæces and urine in bed. The left pupil is wider than the right.

Aug. 6. Death at 8 A.M.

Twenty-six hours later Prof. Jul. Arnold made the autopsy.

Rigor mortis slight; skin yellowish white; but little fat in subcutaneous tissue; muscles light brown. Heart normal, lungs hyperæmic and atelectatic in the lower portions, aerated in the upper; an old broncho-pneumonic focus at the apex of the right lung. Bronchi catarrhal. Spleen moderately enlarged and vascular, with large Malpighian bodies. Both kidneys hyperæmic, but otherwise normal. The liver ex-

hibits numerous fatty spots ; the section has a fatty lustre. The bladder is very much dilated ; urine yellowish and turbid.

In front of the right ear a long wound. Cranium thin but compact ; its very thin diploetic layer is rather hyperæmic. Sutures normal. Dura mater tense and its veins stuffed with blood. The pia mater is also very hyperæmic, and shows at the top of the convexity two patches as large as peas, infiltrated with pus. Over the bony tegmen of the right middle ear the pia mater is adherent to the dura, and both are peculiarly discolored. On lifting the membranes from this place we find a tumor embedded in the petrous bone, which is greatly distended, and at various points perforated, viz. : (1) at the basis and in a backward direction, but without breaking through into the sinus, which showed the normal relations between wall and contents ; (2) in an upward direction ; and (3) in a direction forward.

The tumor itself is nodular, here and there dotted with little granules, and presents the lustre of mother-of-pearl. There was no similar appearance on the left side, and a careful examination made afterwards found nothing abnormal. At the place where the temporal lobe had been adherent to the petrous bone there is an abscess as large as a nut in the brain-substance. The right half of the cerebellum is almost entirely changed into a semi-fluid ichorous mass, which is in close proximity to the fourth ventricle.

The meshes of the pia mater and arachnoid covering the cerebellum, the chiasm, and the crura of the cerebrum, are thoroughly infiltrated with pus. The lateral ventricles are distended with turbid serum, in which float, especially on the right side, a great number of flakes of pus. Around the ventricles the brain-substance is green and soft. The right parotid gland and neighboring cervical glands are quite hyperæmic and infiltrated with serum. Nothing of interest in the larynx and trachea.

The pia mater spinalis, at least in the upper sections, is also infiltrated with pus.

Anatomical diagnosis : cholesteatoma of the right petrous bone. Leptomeningitis purulenta basilaris. Abscess of the right temporal and cerebellar lobes. Purulent inflammation of the ependyma of the lateral ventricle.

After the right petrous bone was removed from the cranium the naked eye appearances indicated a changed condition of the intra-cranial portion. The bony mass was mostly replaced by a soft, laminated, pearly material, which presented a nodular surface—some of the nodules being as large as a walnut.

The tumor was found at the following points:

1. At the angle of confluence of the vertical with the horizontal part of the sinus lateralis; here was the smallest nodule, heart-shaped.
2. At the base of the petrous bone; here the mass extends over both declivities of the petrous, reaching as far forward as the region of the eminentia arcuata, and with its middle portion corresponding very nearly to the destroyed edge, along which the sinus petrosus superior formerly ran.
3. Of the eminentia arcuata only a curvilinear edge was left. In front of it the tumor rose to a height of $1\frac{1}{2}$ ''' and when lifted by a sound it was found to occupy the place of the superior membranous canal and the vestibule.
4. Another mass occupied the place of the bony covering of the antrum mastoideum; and
5. Still another mass, the largest of all, lay in the place of the bony roof of the vestibule, tympanum, and ostium tympanicum tubæ Eustach.

A section through the petrous bone with a fine saw and a more minute examination showed that all of these apparently distinct nodules formed part of one mass, which extended through the entire petrous bone and occupied the majority of its canals and cavities.

Beyond the petrous bone the tumor extended into the mastoid process, occupying all its cells, through the antrum mastoideum into the tympanic cavity, and thence into the inner end of the external auditory canal, whose posterior-superior wall had disappeared. Membrana tympani entirely wanting.

The portion of the tumor occupying the mastoid process appeared to consist of three portions, or zones, diminishing in size, but increasing as regards intensity of coloration from without inward. The inner smallest portion, about as large as a pea, was dark brown. The portion which for size and situation may be called middle was of a lemon color, while the outer and largest zone was white. When treated with

ether and chloroform, the inner portion became somewhat lighter in color, and when tested for hæmin by chloride of sodium and acetic acid the result was negative. The microscope showed fatty detritus and a little cholesterine; the middle zone exhibited a greater degree of fatty degeneration, while the outer zone exhibited a mosaic of closely packed epithelial cells deprived of their nuclei.

The fossa jugularis was well developed, and its bony wall—corresponding to floor of tympanum—was intact.

The structures of the middle ear—malleus, incus, stapes, intrinsic muscles—all gone, and the labyrinth wall destroyed. The membranous sacs and ampullæ, as also the bony and membranous anterior, upper, and posterior semicircular canals were wanting. The tumor extended continuously from the external auditory canal back to the porus acusticus internus, forming part and parcel with the nodule described at 2. The tractus spiralis foraminulentus and the lamina cribrosa were gone; but the opening of the aquæductus vestibuli on the posterior surface of the petrous bone was distinctly visible. The nervus facialis was entirely destroyed as far as the first bend, and the nervus acusticus ended in a slender stump near the point where usually the modiolus of the cochlea begins. The lumen of the cochlea had become an irregular, sinuous space, with nothing left to distinguish its various parts.

In the consideration of this case, three questions present themselves: 1, how long had the tumor been growing? 2, how did it originate? 3, how came about the terminal disease, the leptomeningitis with cerebellar abscess and purulent inflammation of the ependyma of the ventricle?

In regard to the age of the tumor and its origin, the history of the case threw no light upon the early period of the disease. Certainly it had existed more than three months; but that, as in the case of Buhl,* it had

* Nobiling, Contributions from the Pathologico-Anatomical Demonstrations of Buhl. Baier. Arztliches Intelligenzblatt, 1869, No. 33.

existed from youth, seems very doubtful. If this had been the case the patient would certainly have been aware of it, and in some way called attention to it, despite his indifference and want of talent for observation.

At all events, the data in this case are not decisive as to whether the cholesteatoma may be classed among the congenital or the acquired changes of the auditory organ. The difference in size between the cells of such a mass and those normally lining the mucous membrane of the tympanum—a point upon which Buhl lays so much stress—cannot be decisive in itself, since the cellular arrangement of the tumor may keep pace with the general enlargement of the mass.

Perhaps the truth lies between these two views; perhaps sometimes the tumor is congenital, and sometimes acquired.

In regard to the terminal disorder, the question arises as to whether the acute meningitis (and abscess of the brain) which, as in Buhl's case, brought on a fatal result, was an immediate consequence of the caries and pre-existing tumor, or pyæmic from the external abscess, or in connection with the erysipelas?

The post-mortem condition of the pia and dura mater over the right tegmen tympani (adhesion and discoloration) gives an air of probability to the first suggestion; its pyæmic nature would hardly be accepted, considering the absence of chills and the good behavior of the wound to the very last hour. The connection of the meningitis with the erysipelas has some clinical foundation, since death from suppurative intracranial inflam-

mation in cases of erysipelas is not so very rare. Perhaps the local affection of the ear and the erysipelas united in producing this disastrous result.

Respecting the disappearance of bone-tissue caused by pressure of the tumor, the present case is one of the most extraordinary hitherto published.*

The examination of the left petrous bone revealed no abnormal condition.

CASE X.

Emphysema pulmonum. Chronic bronchitis and broncho-pneumonia. Chronic pleuritis on right side. Chronic ulceration of intestine. Purulent catarrh of right ear. Caries of right petrous bone. Erysipelas of the face. Signs of severe brain-disease during life. Death in consequence of œdema of the brain. Absence of any intracranial disease more closely related to the ear-affection.

J. Ebert, a sailor from Neckarsteinach, was admitted to the medical clinic, Sept. 28. 1872, having been picked up by a police officer the day before in a state of insensibility. He was now 50 years of age, had been healthy in youth, and until quite lately able to work at his business.

It was difficult to get much information from him as to his history, but it appeared that several years ago he suffered repeated attacks of fever, and symptoms of an epileptic character, which last appeared about three weeks previous to his admission. Two years ago he fractured the right thigh.

Status præsens. He is in a miserable condition, poor, and covered with pediculi of all kinds. A thorough washing must precede any closer examination. The countenance expresses stupidity and sleepiness, and altogether he presents the appearance of a drunkard. Urine : specific gravity, 1024, and no albumen.

* Compare the case described by me in these Archives, Vol. II., Part I.

Sept. 29, 36.8, 72—37.0, 68. Several baths yesterday and to-day have improved his appearance. Ordered infus. ipecac.

Sept. 30, 37.2, 72—36.8, 70. Examinitio: medium stature; somewhat wasted; thorax barrel-shaped; musculi scaleni; steruno-cleido mastoidei and pectorales well developed; slight œdema of lower extremities. Percussion sound clear on the right side, extending anteriorly farther downward. Area of cardiac dulness not accurately made out. At the back, the lungs extended down to the eleventh intercostal space. Weak respiratory murmur, with distinct fine râles and whistling. Heart-sounds rather weak, but normal in character. Liver and spleen not made out to be enlarged.

Oct. 1, 36.4, 68. Countenance somewhat cyanotic; there is a weak cough, with no expectoration. Ord. ipecac and good diet.

Oct. 2, 72. Fæces passed in bed; less cough. He is stronger, and his general condition improved.

38.0, 84. No stool. Headache. Feels sleepy. Urine partly passed in bed. In the right cheek there is a painful nodule as big as a walnut. Heart-sounds weak, especially over the tricuspid valves. Respiratory sounds everywhere very weak. No rhonchi. Feet œdematous. Urine sp. gr. 1024, and no albumen. Ord. ice-bag to head, ipecac with liq. ammon. anis.

Oct. 3. Urine in bed. No stool. Condition as before. Ord. infus. senegæ, with liq. ammon. anis.

39.2, 96. Some urine in bed. Tongue dry. No more complaint of headache, but of pain in the ileo-cæcal region. Abdominal muscles tense, and belly drawn in. Percussion caused pain on lower right side. Cough. A few rhonchi here and there. Liver enlarged, but spleen not. Still some œdema at the ankles.

Temp. 8 P.M., 38.8

10 " 38.0

12 " 37.0

2 A.M., 36.2

4 " 36.2

6 " 36.0

8 " 36.2

Oct. 4. 36.2, 84. No stool. Urine in bed. Less pain in ileo-cæcal region. Tongue dry. He seems to be less inclined to sleep, coughs a little, and complains of pain in right ear, which is discharging. Says he has had defective hearing four weeks.

3 P.M., 37.6.
6 " 36.6.

Oct. 4. Evening. 37.6, 88. He answers rationally and complains of pains in the limbs.

Oct. 5. 36.4, 72. Slept well last night, but complains of pains in the limbs ; œdema gone.

37.0, 80. Tongue dry and coated. No stool.

Oct. 6. 37.0, 80. Had a good night, and feels better. Respiration easier. Percussion note everywhere sonorous. A few rhonchi. Heart-sound weak, but not altered in character. Tongue coated. Abscess of right cheek opened. Still some appearance of cyanosis. Complains of pains in the legs, but there is no œdema.

38.0, 100. Stool in bed.

Oct. 7. 37.0, 88. More cough ; no expectoration

39.0, 100. Stat. idem. Urine passed in bed several times to-day.

Oct. 8. 37.0, 108. Pains in the legs ; somnolency, and involuntary micturition in bed.

37.8, 96. One evacuation. Stat. id.

Oct. 9. 37.2, 108. He complains of severe pain in the legs. No stool. Otherwise same condition.

Oct. 10. 37.4, 100. He is somewhat stronger. His gait is better, but still quite unsteady. No œdema, no albumen, and less cough. Passed water five times in bed. He answers slowly, but correctly.

37.6, 80. Respiratory sounds weak ; cough.

Oct. 11. 37.0, 92. Stat. id. Still some cough ; one passage in bed.

38.0, 120. St. id.

Oct. 12. 37.8, 100. Drowsy again. Urine and feces passed involuntarily in bed. No appetite. Percussion note everywhere sonorous. Cardiac limits ill-defined. Auscultation : respiratory sounds weak, crepitant râles. Tongue thinly coated.

38, 112. St. id. No stool; and no urine passed in bed.

Oct. 13. 37.4, 112. Drowsy most of the time. Takes no nourishment except when very much urged.

37.6, 92. Stat. idem. Fæces in bed. Urine sp. gr., 1024. No albumen.

Oct. 14. 37.4, 96. He looks better, but is evidently about the same as yesterday. One stool in bed. Attempt to walk more successful than hitherto.

37.6, 96.

Oct. 15. 37.0, 92. Stat. id.

37.4, 88. One fæcal evacuation in bed.

Oct. 16. 37.2, 96. Stat. id.

37.2, 88.

Oct. 17. 37.0, 96. His general condition appears somewhat improved; the cough is gone and the respiration is easier. But he still complains of pain in his legs, the appetite is poor, and the tongue coated. Passed fæces in bed.

37.2, 86.

Oct. 18. 37.2, 104. Stat. id. During the past three days there has been a considerable increase of purulent discharge from the right ear.

37.4, 112. Fæces in bed. Urine sp. gr. 1024, and no albumen.

Oct. 19. 36.8, 100. Stat. idem. Appetite very slight. Little cough. One voluntary fæcal dejection.

37.2, 80. Same state.

Oct. 20. 36.6, 100. But little cough, and no expectoration. Heart's action weak. Urine passed in bed.

37.0, 112.

Oct. 21. 37.0, 100. Stat. id. Urine in bed. One stool.

37.4, 100.

Oct. 22. 36.4, 100. Bowels moved twice in bed. Stat. id. Appetite slight, no cough. Ord. : decoction of cinchona.

Nothing is known with certainty as to the commencement of the discharge from the ear.

The general weakness in all the extremities has been, from the first, remarkable. Most of the time he is apathetic and quite drowsy, but

complaining neither of vertigo nor of headache. When unsupported he becomes dizzy and does not know where he steps. The pupils are normal; there are no symptoms of paralysis of any of the cranial nerves. He usually answers correctly, but appears to have an exceedingly weak memory. The countenance has a very anæmic appearance. The pulse is very small and easily compressible; the heart-sounds are faint. The belly is drawn inward. He continues to have involuntary discharges of urine and fæces. There are no signs of lesions of the internal organs. The clear percussion sound of the lungs overreaches even the normal limits. There is pallor of the mucous surfaces. He appears to be deaf on both sides, for he must be spoken to very loud, and the watch is not heard even when applied to the ear. There has been no delirium.

37.2, 92. Stat. idem. No stool.

Oct. 23. 36.8, 80. No stool. He sleeps most of the time.

37.0, 100. Stat. idem. Urine sp. gr. 1028, and no albumen.

Oct. 24. 36.8, 100. Increased discharge from the right ear. Otherwise no change. No stool.

37.8, 104. Urine sp. gr. 1028, and no albumen.

Oct. 25. 38.0, 112. Pulse small. Stat. id. One stool. He complains of a stinging pain in the right side; but no cause found.

Oct. 26. 37.8, 100. Had a bad night. Passed urine in bed. Bed-sore. No stool. The pain in the right side is gone, and there is no rubbing sound—(pleuritic frottement). Lips remarkably pale. A little albumen in the urine.

At the visit to-day he indicated the right side of the head as the seat of pain. (Encephalopathy? Cerebral abscess?)

36.6, 80. Passed water in bed.

Oct. 27. 36.4, 80. No change. No appetite.

37.2, 100. Stat. id.

Oct. 28. 36.8, 88. Very drowsy most of the time; it is difficult for him to talk. When asked whether he felt pain, and where, he always pointed to the same spot on the forehead.

He complains of considerable dysphagia, and of pain when he attempts to swallow water. On account of pain near the right articulation of the jaw, he cannot open his mouth wide enough to permit a

thorough examination. Passed fæces in bed. Involuntary micturition. The right facialis, especially its lower branches, appears to be less easily excited than the left. Pulse very weak, thready.

39.6, 136. 8 P.M., 40.4. Patient lies in deep sopor. Was finally roused sufficiently to answer that he felt pain in the right side of the head. Urine in bed. Ord. : claret.

8 o'clock.....	40.2
9 "	40.0
11 "	39.8
1 "	39.2
3 "	38.6
5 "	38.4
7 "	38.2

Oct. 29. 38.2, 142. The same drowsiness.

There are two peculiar red spots on the face—one between the right angle of the mouth and the right eye, the other between the bridge of the nose and the canthus of the eye. One stool in bed. To-day he opens the mouth less widely than yesterday. When asked about pain he indicated the right frontal region and the red spots on the face. One stool in bed. Urine 1030, and no albumen.

Oct. 30. 38.0, 120. The red spots have to-day a paler appearance, but have crossed the nose to the left eye ; the nose is swollen and painful to pressure ; the entire right half of the face is swollen and sensitive, and exhibits a scaly eruption. Pulse very weak, hardly perceptible. Cardiac impulse at the normal place, but very faint. In antero-superior parts of the right lung, moist râles ; in left lung, some rhonchi inferiorly. Urine in bed. Ord. : ice-bag.

Afterwards, at the clinic, the lung was found free. Thrombosis sinus lateralis ?

37.6, 120. Nose and upper lip largely swollen. Pulse very weak and counted with difficulty. Involuntary discharges in bed.

Oct. 31. 38.2, 120. (Edema of right eye and lips, but no pain complained of when pressure is made here or elsewhere on the right side of the face. Involuntary micturition in bed. No change in the lungs. Pulse thready.

37.6, 88. Cardiac impulse very weak. Pulse scarcely perceptible

and difficult to count. He cannot open the right eye ; and the left ear is also swollen.

Nov. 1., 7 A.M. Respiration very labored ; pulse imperceptible ; surface cool ; unconsciousness. Death at 8 A.M.

Autopsy (Prof. Arnold). Moderate rigor mortis ; skin yellowish white ; little fat under the skin ; muscles light brown. Nose and entire right half of face infiltrated.

Calvarium thick, compact, and heavy ; sutures normal.

A fresh clot in the sinus longitudinalis. Pia mater diffusely opaque and slightly infiltrated with serum. Both lateral ventricles contain more than the usual amount of clear serum. Ependyma singularly thick, and studded with little grains. In the depth of the anterior portion of the left corpus striatum a portion of the tissue is much softened, and of a peculiar grayish-yellow coloration ; the surrounding tissue is grayish yellow (apoplectic scar). Ependyma of the fourth ventricle granular. General substance of the brain œdematous, moderately vascular, and its consistency diminished. Fresh clots in the sinuses of the dura mater ; dura discolored over the right petrous bone. After removal of dura the bone is likewise found discolored. Meshes of the basal arachnoid infiltrated with serum and gelatinous substance.

The remaining lesions may be briefly included in the following anatomical diagnosis : *Chronic bronchitis and broncho-pneumonia. Emphysema on both sides. Recent lobular foci in the left lung. Chronic pleuritis on the right side, and sacculated collection of pus. Œdema of the brain. Apoplectic scar in the left corpus striatum. Chronic ulceration of intestines. Erysipelas of the face.*

Examination of the petrous bones. Right. External auditory canal and middle ear filled with pus. Lining of auditory canals, posteriorly and superiorly, bluish, much thickened, and easily separated from the bone. Perforation as big as a pea in the centrum of the membrana tympani ; rest of membrane white and thick. Handle not perceptible. Tympanic mucous lining thickened.

Petrous bone carious at five places :

1. On the external surface of the mastoid process, close to the bony auditory canal, a dark spot as large as a bean, forming a pit-like depression which did not communicate with either the external auditory canal or the other carious points;

2. An opening as big as a pea directly over the antrum mastoideum ; and,

3. About one half cm. behind the second, and twice as large ;

4. As large as a pea, on the inner surface of the petrous, near the opening of the aquæductus vestibuli ;

5. As large as a bean, at the basis of the petrous bone, at the confluence of the vertical with the horizontal parts of the sulcus lateralis. At this latter place the wall of the sinus was adherent to the bony canal by a quantity of newly-formed connective tissue ; but in the canal itself no trace of inflammation or sign of phlebitis.

For the sake of saving the preparation, the other parts of the right petrous were not now examined. In a clinical point of view it was not important to examine the parts more minutely.

Left petrous bone. Auditory canal free. Drum-head grayish red and funnel-shaped. Handle not seen.

The mucous lining of the entire middle ear, excepting of the cartilaginous portion of the tube, hyperæmic and hypertrophic. Malleo-incudal joint covered by hypertrophied mucous membrane. Other conditions were not examined.

Without mentioning the former epileptic attacks, which were probably in close connection with the apoplectic scar in the left corpus striatum, there were symptoms enough for a probable diagnosis of a cerebral affection as a complication of the ear disease ; the symptoms were not very much pronounced. Of course it is difficult to say, and indeed, in some cases, may be impossible to satisfy one's self as to whether the intracranial affection be a phlebitis or a thrombosis of a sinus, especially the sinus transversus, or an abscess, or some other brain-affection.

It is just that uncertainty of the symptoms, and our inability to attach them to any other morbid entity, which, according to Griesinger, authorizes us to suppose phlebitis of a sinus. In his essay upon otitic cerebral affections, in the "Archiv für Heilkunde," Bd. III., p. 447, he says: "According to reported cases the diagnosis of 'thrombosis of a sinus' becomes more and more probable by the larger aggregation of certain indeterminate symptoms of a cerebral character, which cannot be attached to any more easily diagnosticable morbid process. Hence the method of exclusion is practised. And when, after the post-mortem examination has demonstrated neither phlebitis nor thrombosis of a sinus nor abscess, our clinical and pathologico-anatomical experience is somewhat bewildered, we are not quite alone in the dark; for Cohn, in his "Clinical Treatise on Embolic Vascular Diseases," page 192, frankly confesses that "now and then, in spite of signs which to all probability indicate a cerebral disease, we find together with caries only œdema of the brain." The anatomical disposition of the parts was as favorable as possible to the occurrence of phlebitis of the right sinus transversus; for its wall lay directly over a carious opening (No. 5).

CASE XI.

Gunshot wound of the skull. Caries of the base of the petrous bone. Phlebitis of the superior and the lateral sinus petrosus. Consecutive inflammation of the internal and the middle ear. Encephalitis.

Francis Picard, of Evensberg, Westphalia, a private in 82d Prussian infantry, was wounded at the battle of Wörth, Aug. 6, and on the 10th admitted to the surgical ward of the Academic Hospital.

Clinical diagnosis: gunshot wound in the temple, shattering the temporal bone. Acute encephalitis. Death, Aug. 23.

Autopsy by Prof. J. Arnold. Cadaver rigid; body strongly built and well nourished; skin yellowish.

There was a large flesh-wound behind the left ear, and another above the ear; in front of these wounds the soft parts were infiltrated with an ichorous substance.

The wound behind the ear led to a passage which took a forward inward direction through the posterior part of the squamous and neighboring part of the petrous bone, into the cranial cavity. The external plate of the perforated bone presented a jagged margin, while the internal plate was very much splintered at the expense of the lamina vitrea. Removal of the calvarium showed a considerable bloody extravasation between the dura and pia, especially at the posterior portion of the occipital lobe. The pia was very much injected, and contained extravasations over the occipital and temporal lobes. The brain itself at these points, and also the neighboring part of the cerebellum, showed the signs of red encephalitis. The changes do not extend deeply, for the diseased layer of brain-substance was nowhere more than 3''' in depth. The mass of cerebrum and cerebellum was somewhat hyperæmic, but otherwise healthy. The wall of the sinus petrosus superior was discolored and covered with pus; but the sinus contained no thrombus. Same condition of sinus lateralis. In the other veins of the basis cranii only fluid blood and fresh clots.

Anatomical diagnosis: Gunshot wound in left temple: gunshot fracture of the temporal bone: phlebitis of sinus petrosus superior and lateralis: traumatic encephalitis. Metastatic foci in both lungs: suppurative pleuritis on both sides. Swelling of the spleen.

Examination of the petrous bone furnished the following data: At the place more minutely described above, a defect of bone as large as a nickel penny. The inner lower edge of the perforation was found at

the end of the descending portion of the sulcus lateralis, while the external edge was formed by that portion of the bone upon which the sinus petrosus superior runs to join the sinus lateralis. The upper margin of the hole is formed by the temporal bone. The base of the petrous bone thus exposed is covered with viscid pus and thoroughly carious. The uninjured part of the petrous is softened, yellowish, and easily permits the knife to penetrate to the bony semicircular canals. The tegmen tympani in the same condition. The mucous lining of the middle ear, as far as the bony portion of the tube and the mastoid cells, much hypertrophied. The uninjured drum-head is opaque and thickened, and slightly drawn inward ; ossicles embedded in the hypertrophied mucous membrane ; malleo-incudal joint movable ; base of stapes hardly movable.

Microscopical examination of the labyrinth showed membranous structures thicker than normal and of a yellowish-white appearance ; small-celled infiltration of the semicircular canals, membranous sacs, lamina spiralis membranacea, and of the connective tissue between the membrana propria of the semicircular canals and the underlying periosteum. The infiltration is most considerable posteriorly in the upper semicircular canals and the connective tissue lying between them and the periosteum ; less marked in the remaining semicircular canals and sacs ; least in the lamina spiralis membranacea.

The membranous wall of the aquæductus vestibuli is much reddened, and the microscope shows it to be covered with red blood-corpuscles.

There is nothing remarkable about the red softening of the brain or the inflammation of the sinus petrosus and lateralis. The changes found in the membranous aquæductus vestibuli doubtless resulted from its inflammation. The inflammation in the labyrinth and middle ear is to be considered a consequence of the injury to the cranium, appearing either at the same time with the inflammation of the bone or subsequently by a continuity of the inflammatory process.

The absence of thrombus from the inflamed vessels is nothing remarkable. It is most probable that the thrombus was molecularly disintegrated, carried into the circulation, and gave rise to the metastatic foci in the lungs.

It is remarkable that there was no blood in the inner ear; the explanation of this evidently lies in the fact that the injury to the petrous bone was by a glancing shot rather than by direct penetration. Concerning this compare my essay on gunshot injuries, in these *Archives*, Vol. II., Part I.

SUPPLEMENT TO THE DESCRIPTION OF AN IMPROVED LID-FORCEPS.

By H. KNAPP.

SINCE the publication of my description of an Improved Lid-forceps, in the first number of this volume, p. 257, the advantages of that instrument have been confirmed by continued experience. At the same time an alteration in its construction has proved useful. When the instrument is closed tight with the screw, its plate should not be at a level with the surrounding ring, but slant in such a way that its free lateral border (near *m* in the figure on page 258) projects about one line over the free lateral part of the ring. The elasticity of the plate and ring are thus taken into account, and when the instrument is used on the eye, the lid does not press the plate lower than to the level of the ring. But if plate and ring are at the same level when the unemployed instrument is closed, the free lateral part of the ring, when the instrument is applied to the eye, will project somewhat over the tarsal cartilage and be in the way of the operator. The slanting position of the plate, as recommended, obviates this inconvenience.

NOTE REGARDING A MODIFICATION OF SNELLEN'S ENTROPIUM-FORCEPS.

BY DR. ARGYLL ROBERTSON, OF EDINBURGH.

WITH the view of overcoming what I conceived to be defects in the construction of the forceps devised by Dr. Snellen, of Utrecht, I got, in 1864, forceps made which differed from Dr. Snellen's in the following particulars: *First*, the handle of the instrument was applied at right angles to the lower margin of the plate. By this modification one instrument will suffice for both eyes; a saving both in expense and trouble is thus insured. *Second*, the narrow (or ring-) blade of the forceps was made to overlap the broad plate to such an extent that the inner border of the ring rested upon the outer border of the plate. *Almost* the whole margin of the lid could thus be exposed to the surgeon's knife, whereas, when Snellen's instrument is used, the parts at the margin of the lid covered by the narrow blade (corresponding in extent to its breadth) cannot be got at. The only other alterations were in the screw, which I got made much coarser, so that the pressure could be more quickly applied and removed, and in the nut, which was provided with projecting "wings" to enable it to be more easily turned.

This instrument I have employed in operations on the lids for the last nine years, and found it to answer

admirably. I have frequently exhibited it to oculists and surgeons visiting Edinburgh, and sent a specimen for exhibition to the meeting of the British Medical Association at Birmingham last year; but I must confess this form of the instrument has not come into general use in this country.

I was delighted to observe in the last number of the *ARCHIVES* that Dr. Knapp, recognizing the defects inherent in the shape of Dr. Snellen's instrument, had independently got forceps constructed similar to mine. In his, however, the narrow blade projects further beyond the broad plate than in mine, and thus stoppage of the circulation is due to bending of the vessels rather than to direct pressure upon them; but the object in both instances is the same, namely, to get more of the free margin of the lid exposed to the knife.

The advantages to be derived from these modifications in the form of Snellen's forceps are so obvious, that I am convinced these improvements will soon be generally adopted both here and in America.

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Fig 1

Tab. I.

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A

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Fig 2 A.

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Fig 4

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Fig 3

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Boettcher del

Carlsberg, No. 111, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

Fig 8



Fig 5.

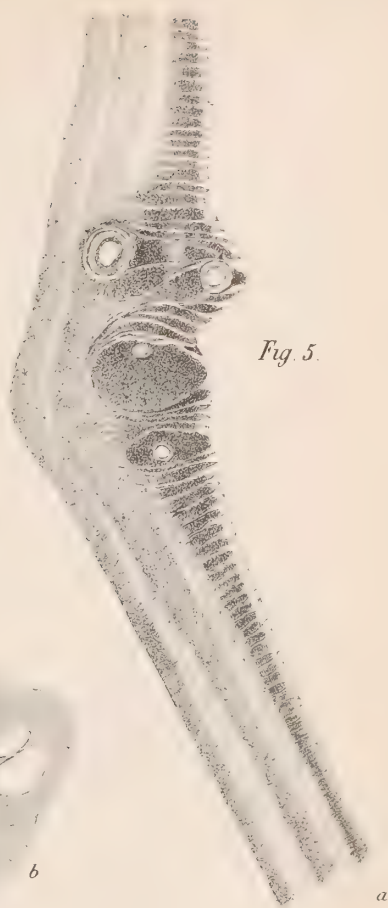


Fig 6



Fig 7.



Fig. 1

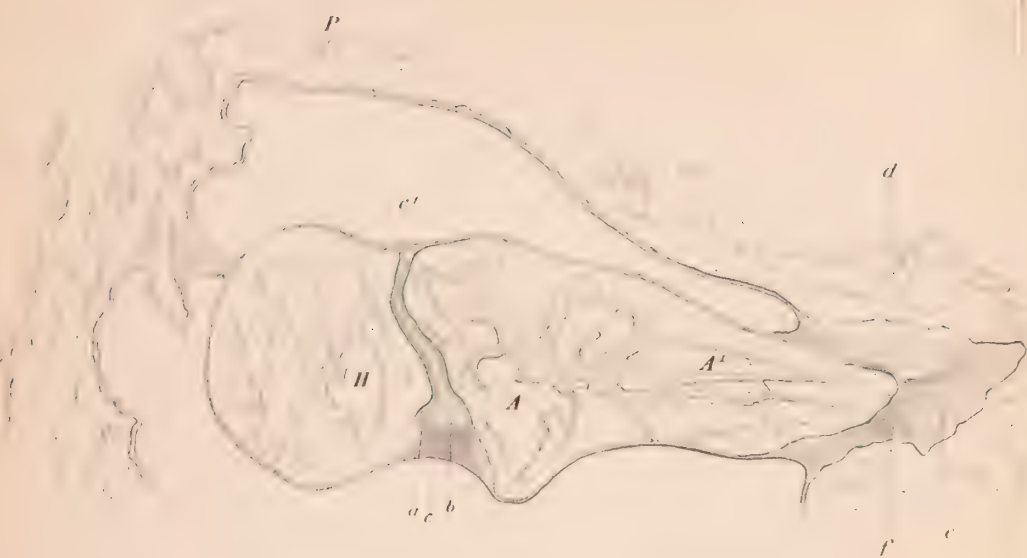


Fig. 3



Fig. 5



Fig. 2

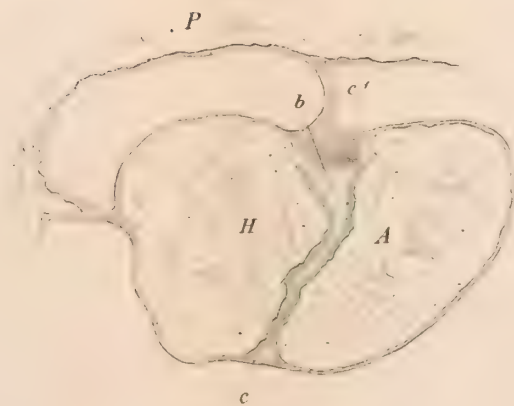
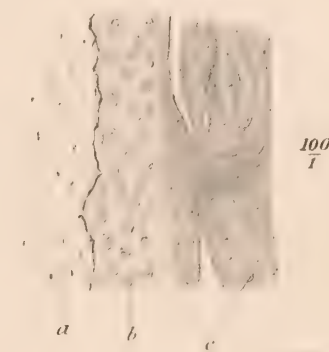
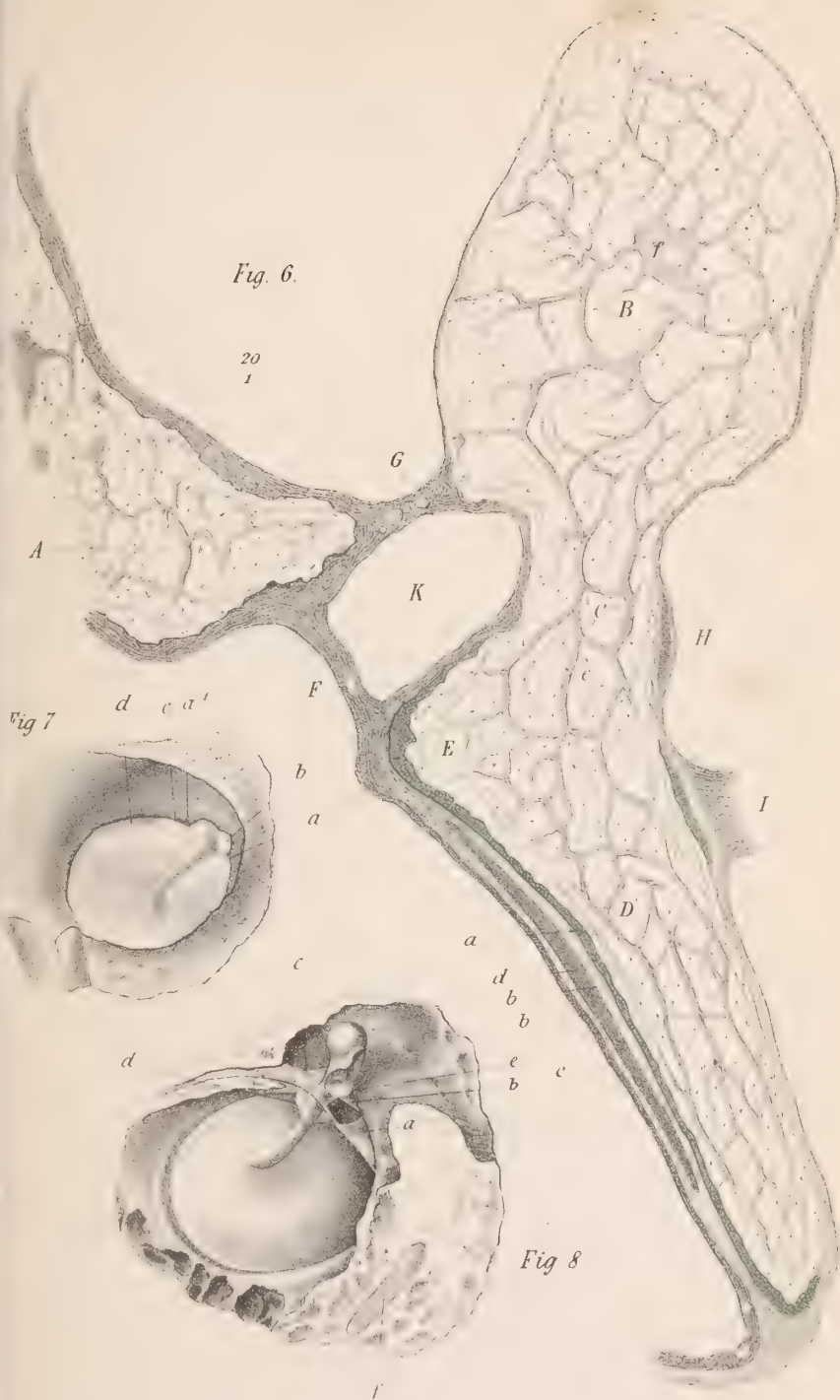
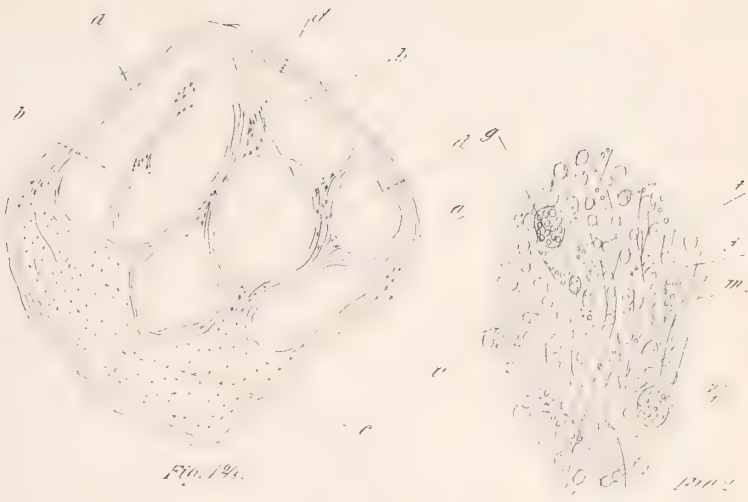


Fig. 4.



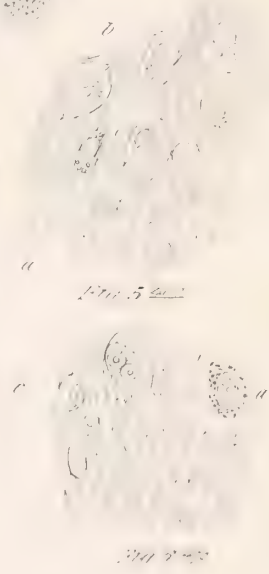
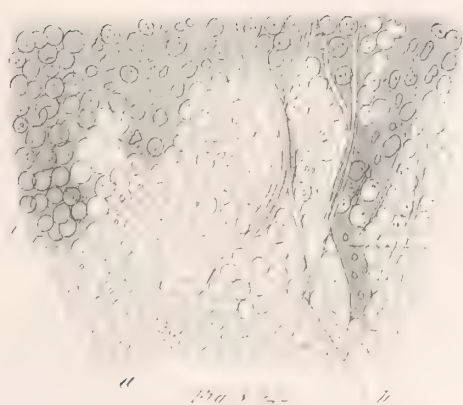
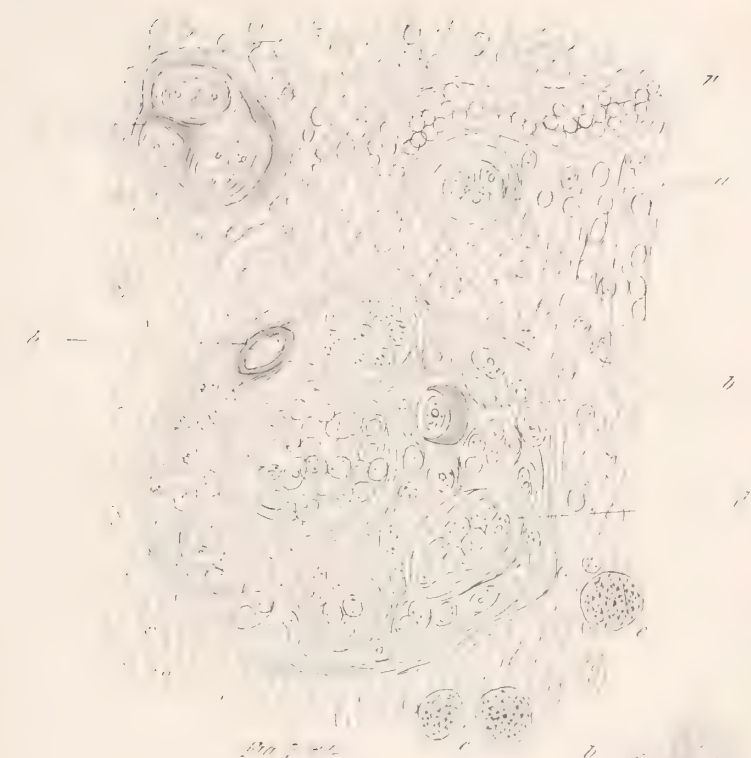
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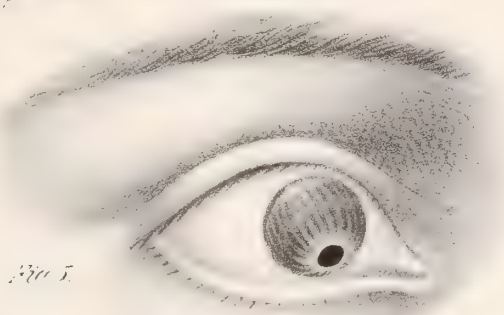




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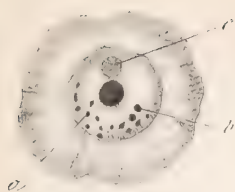


Fig 1 1/2

Fig 6 1/2



Fig 2 3/4

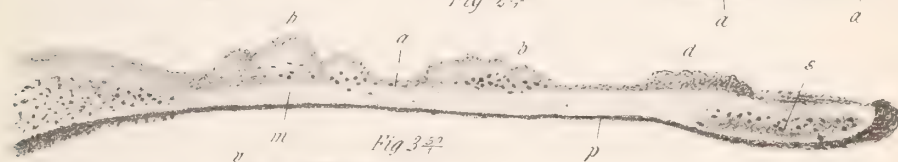
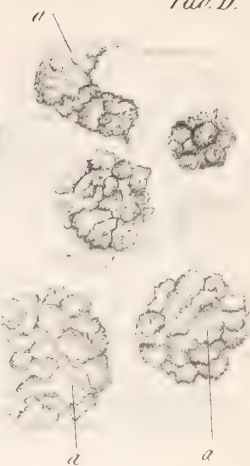


Fig 3 1/2

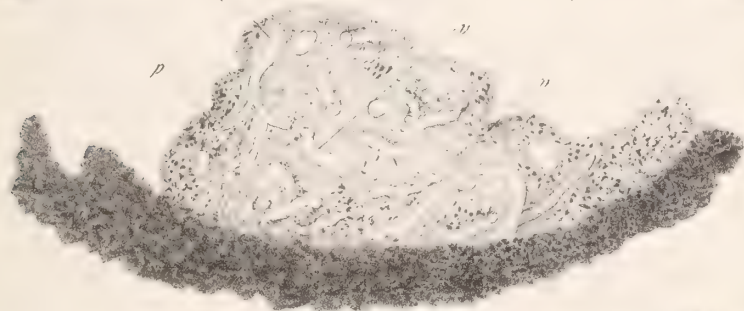


Fig 4 1/2

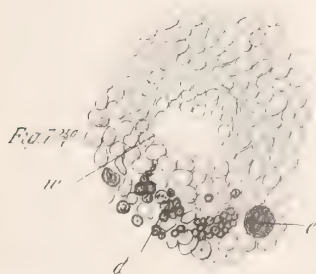


Fig 5 1/2

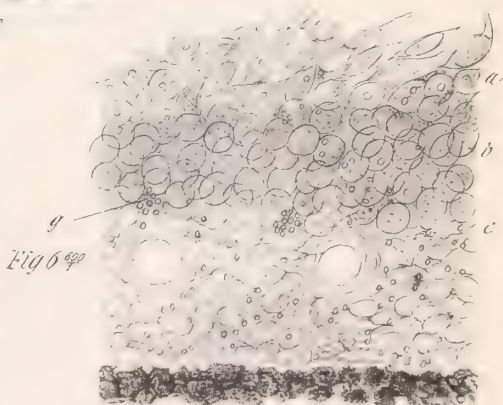


Fig 6 1/2

U. hippocampi

M. muscivora



Fig. 1

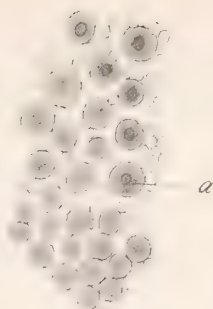


Fig. 2.

Fig. 3.
 $\frac{200}{1}$



b

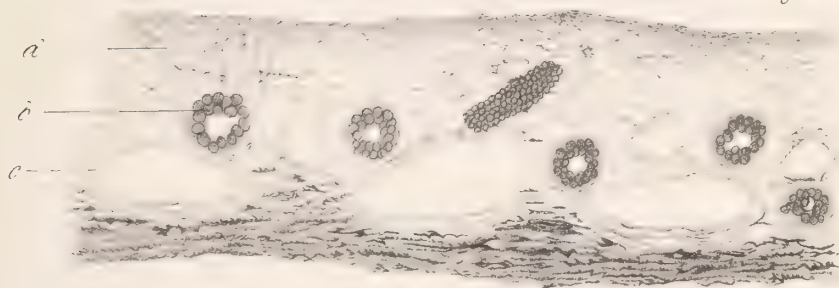


Fig. 4. $\frac{200}{1}$

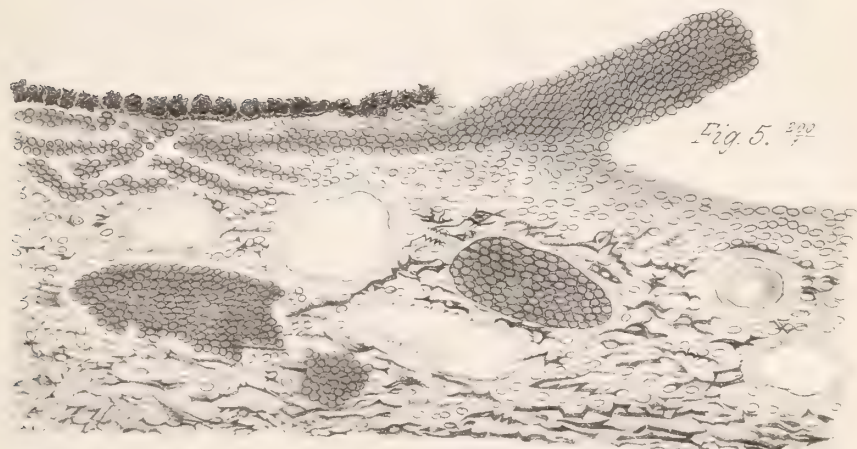


Fig. 5. $\frac{200}{1}$

H. Knapp del.

A. Maserneer sculp.

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